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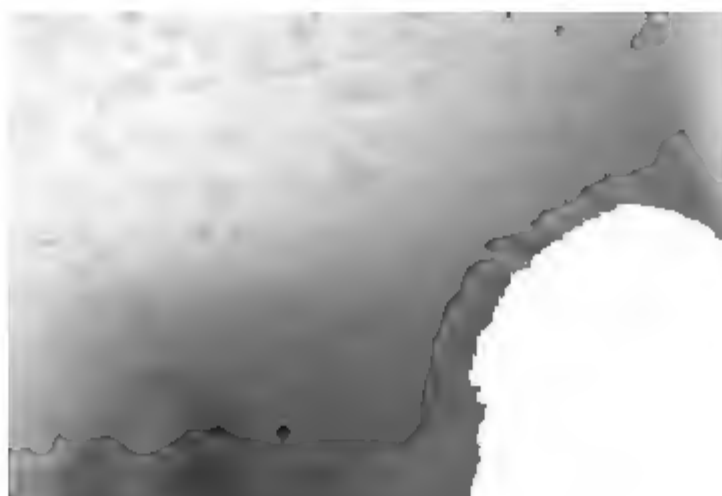
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THE  
DOMESTIC GARDENER'S  
MANUAL:

BEING AN  
INTRODUCTION TO PRACTICAL GARDENING,  
ON PHILOSOPHICAL PRINCIPLES;

TO WHICH ARE ADDED,

A NATURALIST'S CALENDAR;

AN APPENDIX ON THE OPERATIONS OF FORCING, INCLUDING  
THE CULTURE OF VINES IN POTS;

AND

THE ENGLISH BOTANISTS' COMPANION.

BY

JOHN TOWERS, C.M.H.S., M.E.A.S.

---

*A NEW EDITION, ENLARGED AND IMPROVED.*

---

LONDON:  
JOHN W. PARKER, WEST STRAND.

M.DCCC.XXXIX.

1018.



## PREFACE TO THIS NEW EDITION.

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IN presenting to the public this second edition of the *Domestic Gardener's Manual*, I have to acknowledge, with great pleasure, the courtesy and sentiments of warm approval, with which its predecessor was received.

I have made considerable alterations from the plan upon which the work was originally constructed, but I trust that the alterations will be deemed improvements. In making them, I have reason to hope that I may not only meet the views of many enlightened friends, but also promote the extension of science.

Some quotations are omitted; much fresh matter substituted; and, what is of great importance, the various sections have been enriched by extracts from numerous scientific letters, with which, during a correspondence of seven years, I was honoured by the late respected Mr. Knight.

An ample treatise on the Analysis of Soils is added to the first section. In that paper it has been my aim to elucidate every process, and to inquire minutely into the chemical agency of each individual test, leaving nothing to mere routine.

The operations of *Forcing* were not embraced in the first edition: they are now condensed into an Appendix, which I hope will not be unacceptable to amateurs in general.

I entirely disclaim any interference with the practice of gardeners by profession. These able men—the pupils of experience—are in a safe and honourable path; let them proceed in it. Yet I may be permitted to hope that, by stimulating them to investigate the science of their art, and to seek the light of philosophy, I may add to their pleasure, and dignify their profession.

To those Noblemen and scientific gentlemen who have honoured me with unequivocal proofs of their approbation, I beg to offer my sincere and respectful thanks.

To Dr. Faraday, of the Royal Institution, I am particularly indebted. To his gratuitous kindness, I owe the possession of the series of his *New Researches in Electricity*, a compendium of luminous facts that, to me, are invaluable; the more so, as they bear forcibly upon the universal agency and distribution of the ethereal essence, which appears to connect all the great natural phenomena of the creation.

J. T.

May, 1839.

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## ABSTRACT OF THE PREFACE TO THE FIRST EDITION.

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So many books on horticultural subjects—some of them of the highest order of merit—being, as it were, in the hands of every one, it may appear superfluous, if not wholly useless, to introduce another to the notice of the public. In order, therefore, to justify this attempt, it will be proper, in the first place, to state some of the reasons which have induced me to produce this work, and then to give an account of the nature of the work itself.

Most of the works on gardening which have come under my observation, are not only expensive, but appear to have been written almost exclusively for the affluent;—for those who possess, or can afford to possess, all the luxuries of the garden. We read of the management of hot-houses, green-houses, forcing-houses; of nursery-grounds, shrubberies, and other concomitants of ornamental gardening. Now, although it is acknowledged that many useful ideas may be gathered from these works, still it is obvious that they are chiefly written for those whose station in life enables them to employ a chief gardener and assistants, qualified for the performance of the many operations required in the various departments of large gardens. As I profess to have a very different object in view, I address this book to those, who, without aiming to become professional gardeners, wish, nevertheless, to acquire so much of the art of gardening as shall enable them to conduct its more common and essential operations with facility and precision, and to produce

those results which have hitherto been considered as attainable only by high professional skill and experience.

There are many, doubtless, who are desirous of cultivating their own gardens as a means of obtaining and establishing health; and others, heads of families, who feel it a duty to economize in everything; who wish to employ their own hours of leisure, and to *educate*, or, in the literal and proper sense of the word, to *bring up*, one or more of their children in the innocent and useful pursuits of domestic horticulture. To such, a cheap publication, containing plain and intelligible instructions, upon scientific principles, for every month of the year, must, it is presumed, be found a valuable acquisition, by enabling them to obtain, at a moderate expense, practical directions on the means best calculated to make the most of a piece of garden-ground, and to render it as productive as possible.

The work consists of twelve principal divisions, devoted respectively to the twelve months of the year, and subdivided into three sections for each month. The First Section embraces subjects connected with the science or philosophy of gardening;—such as the nature and agency of earths and soils; of electricity, water, the atmosphere, light, heat, &c.; of the structure and vascular system of plants, the motion of the sap, and the laboration of the proper juice.

The Second Section contains an account of the natural history, generic and specific characters, and cultivation of one or more of the chief esculent vegetables; to which succeed directions for the operations in the kitchen-garden during the current month.

The Third Section treats of the natural history, &c., of the most esteemed fruit-trees; and contains directions *for the management* of the fruiting department during

the month; to these are added miscellaneous observations on the treatment of flowering shrubs, evergreens, flower-borders, &c.

As it is presumed that many readers are curious in searching for facts connected with natural philosophy, and that others are attached to botanical pursuits, I have added a concise *Naturalist's Calendar* for each month in the year. A *Botanical Catalogue* of British indigenous plants is also added. In this the species are arranged not only in their respective classes and orders of the Linnæan system, as enlarged and improved in the last edition of Sir JAMES EDWARD SMITH'S *English Flora*, but in the *monthly order in which they severally flower*. Thus the English botanist will find a *vade mecum*, calculated to assist him in his endeavours to identify every plant which he may find in flower at any period of the year.

Such, then, is the general plan of the work; but to enable the reader to understand its particular objects, something further remains to be said. It is my earnest desire to enlarge the circle of science, to disseminate it in quarters where, till lately, it has been comparatively unknown; and, above all, to excite an inquiry after truth. Conceiving that I shall most readily attain my object, by enabling the reader to examine and compare the various opinions and hypotheses advanced by scientific men, I have given throughout the work concise selections and extracts from the writings of some of the most eminent chemists and philosophers; to which, I have occasionally added such remarks as the nature of the subjects, and the result of my own reflection and experience appeared to require and authorize. The work, therefore, may be considered as a compendium, or book of reference, from which the reader may draw his own conclusion on the present state of science, particularly that termed *electro-chemical*:

and on its probable applicability to the practice of horticulture.

The selections have been chiefly made from the writings of Lavoisier, Henry, Thompson, and Parkes. I have derived much assistance from those of Sir James Edward Smith; from the *Mathematical Dictionary* of Dr. Hutton; the *Calendar and Dictionary* of Abercrombie; the *Gardener's Remembrancer* of M'Phael; and from that elaborate and interesting work, *The Encyclopaedia of Gardening*, by Mr. Loudon: a volume, which is in itself a magazine of scientific research, and practical information.

At a time when knowledge is spreading in every direction, when our operatives and mechanics give promise of adding to the number of our enlightened characters, and when many of the sciences, both physical and mechanical, are laid open to their research, can there exist any just cause why such men should not be instructed in the true principles of agriculture and gardening?

I am not aware that any *cheap* publication has hitherto appeared, which pretends to treat of gardening as a science of induction. Believing it to be such, and that to attain any perfection in the *practice*, it is indispensably necessary to acquire some knowledge of the *philosophy* of the art, I have felt it my duty to call the reader's attention to the operations of those natural agents by which all the phenomena of vegetation are induced. Peculiar stress has been laid upon the agency of Electricity, with the view to excite close investigation into that branch of the philosophy of nature, which appears to have been the most neglected, although there is little reason to doubt that it contains the germ or embryo of that true science, which, if it ever fully develope itself, will scarcely fail to make

manifest, causes and effects that have heretofore been involved in inextricable mystery.

The late Professor Playfair once observed, “If we consider how many different laws seem to regulate the action of impulse, cohesion, elasticity, chemical affinity, crystallization, heat, light, magnetism, electricity, galvanism; *the existence of a principle more general than these, and connecting all of them with that of gravitation, appears highly probable.* The discovery of this great principle may be an honour reserved for a future age; and science may again have to record names which are to stand on the same levels with those of Newton and Laplace.” He added, “it were unwise to be sanguine, and unphilosophical to despair.”

The conjecture of this great man has, to a certain extent, been verified; and it may not be presumptuous to conjecture, that “the great principle” itself will ultimately be referred to one grand and only source.

I believe, that this source is already discovered and known, and that it only requires the philosophic mind to divest itself of prejudices, and to cease from pursuing shadows, since the substance itself stands revealed to the view of all. If I succeed in rendering this apparent, I shall enjoy the satisfaction of having done something for the cause of science, by simplifying the means of scientific research into the operations of that grand principle, which I cannot but view as the source of, and prime operative agent in, all the phenomena of the material world.

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# ORIGINAL DEDICATION.

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TO

THOMAS ANDREW KNIGHT, ESQUIRE,  
*PRESIDENT TO THE HORTICULTURAL SOCIETY.*

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SIR,

I CANNOT do myself a greater honour than to dedicate **THE DOMESTIC GARDENER'S MANUAL** to a gentleman from whose scientific researches and labours I have derived great improvement, and the highest gratification. I therefore present it to you—not only as a tribute of gratitude for the invaluable instruction I have received, but as an acknowledgment of the heartfelt pleasure conferred upon me by the kind and affable manner in which you have signified your permission that I should dedicate my work to you.

There are few scientific horticulturists, Sir, who are not aware of, and do not fully appreciate the great service that you have rendered to the practice of Gardening in general, and to the science of *Vegetable Physiology* in particular; but it may not, perhaps, be generally known, that the catalogue of “British Works on Gardening,” in Mr. LOUDON'S *Encyclopædia* of the year 1824, contains a list of no fewer than one hundred and sixteen treatises or papers on various important subjects connected with theoretic or practical horticulture, which claim you as their author.

To these writings, I invite the attention of every inquiring reader who is in quest of phytological knowledge, because I am persuaded that thereby I shall effect an object dear to you, Sir, as well as to myself—namely, *to arouse a spirit of research into the elementary components of plants, with a view to the increased production of animal sustenance.*

I may be permitted to observe, that recent, well-conducted experiments have proved that excellent and salubrious wines can be

made from the leaves of the vine, and the roots of the parsnep, and have rendered it extremely probable that sound good beer may be brewed at a very trifling expense, from mangel-wurtzel. In the economy of the farm-yard, Indian corn, and the seeds of the sunflower—on account of the exceedingly nutritious properties that they possess, and the facilities with which they may be produced—are likely to become articles of primary importance in rearing poultry of all descriptions.

These are but a few among the many facts that might be adduced—all tending to prove the necessity of reiterated experiments and minute investigations—all confirming the accuracy of the following observations, which I take the liberty to extract from the excellent letter you have recently addressed to me:—

“Horticulture, as a science, has much in it to benefit and delight; and it may justly be said to be still in its infancy,—for I am perfectly confident that we have scarcely yet a single species of fruit, or esculent plant, which is not still capable of being much improved relatively to the use of man. Of the powers of the *potatoe* to supply us with animal food, no person has yet formed anything approaching a fair estimate.”

After this, it would be superfluous to add another word; for if such remarks, coming from such high authority, and supported by so many self-evident facts, fail to stimulate the gardener to patient and persevering research, all that I could further adduce, would be of little avail.

May your honourable and useful life be long preserved to us!—May it be accompanied with the blessings of health, and increasing mental enjoyment!

I beg to subscribe myself, SIR,

With great respect,

Your obedient and obliged Servant,

THE AUTHOR.

August 4, 1830.

# CONTENTS.

	PAGE
PRELIMINARY OBSERVATIONS.—VEGETABLE CHEMISTRY . . .	1

## JANUARY.

§ I.	
	PAGE
Nature and Offices of Earths and Soils, and their analysis . . .	7
Manure and Composts . . .	25

§ II.	
ESCULENT VEGETABLES of the	
LEGUMINOUS TRIBE . . .	31
The Garden Bean . . .	31
The Pea . . .	33
The Kidney-bean . . .	38
Garden Implements or Tools . . .	41
Operations in the Vegetable Garden . . .	42

§ III.	
Of POMIFEROUS, or KERNEL	
FRUITS . . .	43
The Apple . . .	43
The Pear . . .	48
The Quince . . .	50
The Medlar . . .	51
Operations of the Fruit Department . . .	51
Miscellaneous . . .	52
The Naturalist's Calendar . . .	52

## FEBRUARY.

§ I.	
Electricity . . .	54

§ II.	
VEGETABLES of the SPINDLE-	
ROOTED TRIBE . . .	71
The Red Beet . . .	71
The Carrot . . .	73
The Parsnip . . .	74
Operations in the Vegetable Garden . . .	77

§ III.	
STONE FRUITS . . .	78
The Peach-tree . . .	78
Operations in the Fruit Department . . .	84
Miscellaneous . . .	85
The Naturalist's Calendar . . .	85

## MARCH.

§ I.	
WATER . . .	87
Nature of Water . . .	87
Constituents of Water . . .	95
Water one of the great natural Agents . . .	103

§ II.	
VEGETABLES of the CABBAGE	
TRIBE . . .	112
The Cabbage . . .	112
The Red Cabbage . . .	117
The Savoy . . .	117
Brussels Sprouts . . .	118
Borecole . . .	119
Cauliflower . . .	120
Broccoli . . .	122
Operations in the Vegetable Garden . . .	124

§ III.	
STONE FRUIT-TREES ( <i>Continued</i> )	
The Nectarine . . .	125
The Almond . . .	126
Operations in the Fruit Department . . .	126
Miscellaneous . . .	127
The Naturalist's Calendar . . .	128

	PAGE		PAGE
<b>APRIL.</b>		<b>§ III.</b>	
<b>§ I.</b>		<b>FRUIT-TREES . . . . .</b>	<b>263</b>
The ATMOSPHERE, Nature and		The Cherry-Tree . . . . .	263
Phenomena of . . . . .	130	The Fig-Tree . . . . .	267
Modification of Clouds . . . . .	144	Operations in the Fruit Department	276
<b>§ II.</b>		Miscellaneous . . . . .	276
Asparagus . . . . .	147	The Naturalist's Calendar . . . . .	278
Operations in the Vegetable Garden	159		
<b>§ III.</b>		<b>JULY.</b>	
The Apricot-Tree . . . . .	160	<b>§ I.</b>	
Operations in the Fruit Department	166	<b>VEGETABLE PHYSIOLOGY.—</b>	
Miscellaneous . . . . .	166	<b>PART II. . . . .</b>	
The Naturalist's Calendar . . . . .	166	Internal or Vascular Structure	
		Functions of the Organs . . . . .	
<b>MAY.</b>		<b>§ II.</b>	
<b>§ I.</b>		<b>ESCULENT ROOTS . . . . .</b>	
LIGHT, Nature and Properties of	169	The Turnip . . . . .	
HEAT, Nature of . . . . .	169	The Radish . . . . .	
Phenomenon of Dew . . . . .	188	Celery . . . . .	
<b>§ II.</b>		Celeriac . . . . .	
<b>TUBEROUS-ROOTED VEGETABLES</b>		Operations in the Vegetable Garden	
The Potatoe . . . . .	197	<b>§ III.</b>	
The Jerusalem Artichoke . . . . .	210	The Black Mulberry . . . . .	
Operations in the Vegetable Garden	211	Operations in the Fruit Department	
<b>§ III.</b>		Miscellaneous . . . . .	
The Plum-Tree . . . . .	212	The Naturalist's Calendar . . . . .	
Operations in the Fruit Department	223	<b>AUGUST.</b>	
Miscellaneous . . . . .	223	<b>§ I.</b>	
The Naturalist's Calendar . . . . .	225	<b>VEGETABLE PHYSIOLOGY.—</b>	
<b>JUNE.</b>		<b>PART III. . . . .</b>	
<b>§ I.</b>		Phenomena of Vegetable Life	
<b>VEGETABLE PHYSIOLOGY.—</b>		<b>§ II.</b>	
<b>PART I. . . . .</b>		<b>ESCULENT VEGETABLES. . . . .</b>	
External Organs of Plants . . . . .		The Artichoke . . . . .	
<b>§ II.</b>		Spinach, or Spinage . . . . .	
Ben Kale . . . . .	248	New Zealand Spinach . . . . .	
Indian Corn, or Maize . . . . .	254	Operations in the Vegetable Garden	
Operations in the Vegetable Garden	262	<b>§ III.</b>	
		<b>BERRY-BEARING SHRUBS . . . . .</b>	
		The Currant . . . . .	
		The Gooseberry . . . . .	
		Operations in the Fruit Department	
		Miscellaneous . . . . .	
		The Naturalist's Calendar . . . . .	

## SEPTEMBER.

PAGE

## § I.

CONSTRUCTION OF A GARDEN	395
Object of Gardening . . .	395
Situation and Soil . . .	396
Preparation by Trenching . .	404
Protection and Shelter . . .	412

## § II.

ESCULENT VEGETABLES . . .	422
The Lettuce . . . . .	422
Endive . . . . .	426
Operations in the Vegetable Garden	430

## § III.

The Raspberry . . . . .	431
Operations in the Fruit Department	436
Miscellaneous . . . . .	437
The Naturalist's Calendar . .	438

## OCTOBER.

## § I.

CONSTRUCTION OF A GARDEN, (continued) . . . . .	439
Extent of the Garden, and Plan	439
Laying out the Area . . .	442
Planting the Garden . . .	450
Arrangements of the Orchards and Screen . . . . .	461

## § II.

ESCULENT VEGETABLES—SA- LADING . . . . .	474
Mustard and Cress . . .	474
Corn Salad . . . . .	476
Indian Cress, or Nasturtium .	477
Parsley . . . . .	478
Operations in the Vegetable Garden	479

## § III.

BERRIED FRUITS . . . . .	480
The Strawberry . . . . .	480
The Cranberry . . . . .	486
Operations in the Fruit Department	488
Miscellaneous . . . . .	488
Naturalist's Calendar . . .	490

## NOVEMBER.

PAGE

## § I.

SCIENTIFIC OPERATIONS OF GARDENING . . . . .	491
Operations of Propagation . .	491
Operations preparatory to graft- ing . . . . .	509
Propagation of Forest Trees . .	514

## § II.

ESCULENT VEGETABLES . . .	518
The Onion . . . . .	518
The Leek . . . . .	523
Chives . . . . .	524
Garlic . . . . .	525
The Shallot . . . . .	525
Operations in the Vegetable Garden	526

## § III.

Natural History and Cultivation of the Grape-Vine . . . . .	527
Operations in the Fruit Department	538
The Naturalist's Calendar . .	538

## DECEMBER.

## § I.

SCIENTIFIC OPERATIONS OF GARDENING . . . . .	539
Operations of Grafting and Bud- ding . . . . .	539
Operations of Pruning and Training . . . . .	563
Operations productive of Fruit- fulness . . . . .	572

## § II.

ESCULENT VEGETABLES . . .	575
Horse-Radish . . . . .	575
Rhubarb . . . . .	577
Operations in the Vegetable Garden	579

## § III.

Cultivation of the Grape-Vine (continued) . . . . .	579
Operations in the Fruit Department	589
Miscellaneous . . . . .	589
The Naturalist's Calendar . .	589

APPENDIX.

	PAGE		PAGE
ON THE FORCING OPERATIONS		The Cucumber . . .	608
OF THE GARDEN . . .	591	The Persian Melon . . .	616
The Vinery . . . .	592	The Pine-Apple . . .	622
The Strawberry . . .	606		

THE ENGLISH BOTANIST'S COMPANION:

A CATALOGUE OF PLANTS FOR EVERY MONTH IN THE YEAR, WITH THE  
LATIN AND ENGLISH NAMES, AND THE CLASS AND ORDER  
TO WHICH THEY BELONG.

January . . . 631	May . . . 635	September . . . 673
February . . . 631	June . . . 641	October . . . 676
March . . . 631	July . . . 651	November . . . 677
April . . . 632	August . . . 664	December . . . 677

INDEX . . . . .	679
-----------------	-----

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## PRELIMINARY OBSERVATIONS.

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GARDENING, in common with the other arts, has, during the progress of the nineteenth century, become a subject of scientific investigation, and is no longer to be considered as a matter of mere routine practice. Knowledge, such as may be attained from the treatises of the old school,—or, to speak more correctly,—information, concerning the mechanical operations of digging and cropping the ground at specified periods, is doubtless of considerable utility; nevertheless, if practice be not founded upon the true principles of science and philosophy, there can be no certainty whatsoever of attaining successful results. Men may be industrious and watchful; they may call in aid all the mechanism of the art; still, however, owing to the exhaustion of the soil, or to the operation of natural causes but little understood, and probably not even suspected, their efforts may be baffled, and their hopes terminated by disappointment.

This being the case, it becomes the indispensable duty of every one whose aim it is to understand any of the phenomena of vegetation, to inquire what are the nature, constitution, and offices of the agents by which such phenomena are produced, with the express view to acquire some knowledge of general principles, which may be reducible to practical utility.

*The science of Gardening* consists chiefly in a knowledge of those agents which nature employs in the production of vegetable organized matter. These agents are numerous, and one or more of them, as has been already said, will come under consideration, and form the subject-matter of the leading section of each month. The first, and that which calls for the earliest notice as a primary agent, is *the soil*, its nature, and composition. But before we enter into an examination of the soil in which plants grow, and in order to obtain correct ideas on the subject of vegetable nutrition, it seems essential to devote some attention to the primary principles of plants themselves, and to inquire into the nature of those products of vegetable bodies, which have been obtained by the operations of analytic chemistry. We start upon true principles, when by any means we are enabled to determine the component parts of a vege-

table organized being; for, if these be clearly ascertained, it follows, as a necessary consequence that, by supplying that being with substances or matters which primarily contain, or are ultimately resolvable into its own constituent elements, we adopt the means best calculated to enable its organs to absorb nourishment suitable to its future growth and development.

Experiment has determined, that whatever be the parts of trees and plants that are submitted to the test of chemical analysis, whether it be the root, stem, branches, or leaves, the result is very nearly the same: they are all found to produce oxygen, hydrogen, and carbon, either separately, or united in various forms and proportions. These are terms which persons who are wholly uninitiated in the language of chemistry, may find, for a time, some difficulty to comprehend. Terms of science, which require elucidation, must, however, be occasionally employed; but it is hoped that, in the course of the work (although it is not to be considered a regular chemical treatise), so much elementary information will be conveyed, as shall not fail to remove many difficulties, to interpret and render perspicuous many heretofore unintelligible phrases, and gradually to lead the reader on, step by step, till he acquire a thorough relish for chemical pursuits, particularly when they are taken in connexion with vegetable physiology.

Trees and plants yield a variety of compound products, possessing very different properties, and the greater part of them of essential utility to man. Among these products may be named—sugar, starch, gluten, gum, vegetable extract, bitter extractive, tannin, the colouring principle, acids, essential oils, the fat or fixed oils, resins, gum-resins, balsams, camphor, cork, &c.; also the sap, or ascending common juice; and the laborated sap, or proper juice,—the origin of the foregoing secreted products.

When these vegetable productions have been subjected to chemical analysis, they have been found to yield chiefly, *carbon*, *oxygen*, and *hydrogen*; and in some of them a portion of *azot*, or *nitrogen*, has been detected.

Vegetables are found to contain two of the alkalies, namely, *potass* and *soda*, also two or more of their neutral compounds, as carbonate of potash, and muriate of soda (common salt). Nitrate of potash (salt-petre), is abundant in a few vegetables. The three earths, lime, or its carbonate, silica, and alumina, are traceable after burning; less frequently in the crude vegetable substance. The alkalies are abundant in the ashes of some plants; but it may be questioned, whether, in all cases, they exist originally in the plant, *or are the results* of combustion. However, De Saussure found

that the ashes of the golden rod, bean, turnsole, and wheat, yielded three-fourths of their weight of alkaline salts. The potass of commerce is produced from the ashes of trees and inland plants; soda is obtained from marine plants, and chiefly from *Salsola soda*, and other species of the genus *Salsola*, known by the name of kelp. Lime is more abundant than any of the earths, and is usually found in combination with carbonic acid. The *phosphate* of lime is said to be most abundant in the ashes of green herbaceous vegetables. *Flint* (silica) has been detected by Sir Humphry Davy in the outer skin or cuticle of the grasses, and of several other plants. "From 100 parts of the cuticle of the following plants, the proportions of silica were,—in the bonnet-cane, 90 parts; bamboo, 71·4; common reed, 48·1; stalks of corn, 66·5. Owing to the silica contained, the plants in which it is found are sometimes used to give a polish to the surfaces of substances, where smoothness is required."

*Magnesia and alumina* have hitherto been found only in very small quantities, and in few plants; the former, chiefly in *salsola*, and in some marine fuci (sea weeds).

*Metallic oxides* are sometimes present in the ashes of vegetables. The oxide of iron is the most common and abundant; and it has been found in the ashes of the oak, and of other hard-wooded plants, to the extent, it is said, nearly of one-twelfth of their weight. "It has been observed by De Saussure, that the proportion of oxides of iron and manganese augments in the ashes of plants as vegetation advances: the leaves of trees furnish more of these principles in autumn than in the spring."

The only alkaline substances discoverable in the *ashes* of vegetables, appear to be potass and soda; but the recent experiments of the French chemists have detected, in several parts of vegetables, certain substances which exhibit alkalescent qualities. In one of these obtained from *opium*, the essential *soporific* qualities of that singular exusion from the poppy, have been found to reside; and to this substance, chemists have bestowed the characteristic name of *morphia*. The Peruvian bark also furnishes two alkalescent substances: one is termed *cinchonia*, and the other *quina*: the latter, when in combination with the sulphuric acid, forms the celebrated *sulphate of quina*.

The term *alkaloid* is now applied to that principle which recent experiments have discovered to exist in most active medicinal plants. It exerts an alkalescent power; and thus, the bitter principle of the hop (*lupuline*) tends to preserve beer, by preventing the process of acetification.

Chemical analysis has discovered several other substances in

which the peculiar medicinal properties of different vegetable productions appear exclusively to reside: thus, the emetic property of ipecacuanha root, depends upon a principle styled *emetine*, which appears to exist in the proportion of about one-sixtieth part of the whole.

If it be asked by what means the knowledge of the ultimate constituents or elements of the vegetable organs, and their various productions, has been attained, it may be answered, that the processes are both difficult and complicated; and of this, any one may be convinced, by a simple inspection of the plates annexed to Lavoisier's *Elements of Chemistry*. Fermentation, distillation, maceration, infusion in water and in alcohol, the actions of acids and alkalies,—all have been resorted to. In one of these processes, that of *fermentation*, the particles of vegetable matter are induced by *electric agency* to enter into new combinations, and to form fresh compounds; some of these are *gases*, or *elastic fluids*, which being collected in appropriate receivers, and examined by chemical tests, are found to possess properties in common with other gases, whose component parts had been previously ascertained. Carbonic acid is one of these products of vegetable fermentation; and carbonic acid has been proved to be composed of about twenty-seven and a-half parts of carbon (pure charcoal), and seventy-two and a-half parts of oxygen; hence, carbon and oxygen are ascertained, by experiment, to exist in vegetables.

*Distillation*, particularly that process which is termed destructive distillation by fire, is a powerful agent, by means of which some of the component parts of vegetable matter have been discovered. If wood be enclosed in iron cylinders, which are connected by tubes, with vessels calculated to receive and separate all its liquid and gaseous products, and then submitted to the action of fire, it will yield an acid liquor, which was formerly known by the name of *pyro-ligneous acid*, but has since been found to be vinegar, or acetic acid, in an impure state; this, when purified, is the colourless, or “radical vinegar,” that is in general use for culinary purposes. This acid product, and common vinegar also, are proved to be reducible into the ultimate elements—oxygen, hydrogen, and carbon. The cylinders are found to contain charcoal, which exhibits the exact form, even of the layers and fibres of the wood which was made use of.

*Charcoal*, when properly prepared, is carbon united to a small portion of oxygen and earthy matters: it is, therefore, an oxide of carbon, its base being pure carbon; of which base the *diamond* affords the only known example. The conclusion from all that has

been advanced is, that trees and plants contain a large portion of carbon, and that it forms one of their chief constituent elements.

From what has been said, some idea may be formed of the processes by which the elements of vegetables have been ascertained; and if these processes are ably and carefully conducted, the results are certain and invariable. Should the objection be started, that destructive distillation by fire must, to all intents and purposes, produce a total change of the substances acted upon, and that the destruction of a body, can never with propriety be considered as a fair examination of the elements of which that body is composed; it may be admitted that it would be difficult to reply to so plausible an objection, were it not certain that nature herself effects the decomposition of her vegetable and animal productions, by a process (more tardy it is true, but) closely resembling in its results, the hasty and violent operations of the analytic chemist; for if a collection of vegetable or animal matter is exposed to the action of air and moisture under a certain degree of atmospheric heat, a chemical process commences, which gradually, but totally, decomposes the mass, separates its natural elements, and forms new gaseous, liquid, and solid compounds, of which the two former resemble those produced by direct chemical analysis, and clearly indicate the presence of oxygen, hydrogen, carbon, and nitrogen, while the solid remains consist chiefly of earthy and saline substances, abounding with charcoal. *Chemical action, then, decomposes the parts of vegetable organized beings, develops and forms gaseous and solid compounds, which are in every respect qualified to become the food of the vegetating plant; and vegetable vitality in its turn, seizes upon the products of chemical fermentation and decomposition, and appropriates them to the formation and nourishment of all those component parts and organs which constitute the vegetable organized being.*

I have so far conformed to the ordinary language and views of chemical philosophers; but as it is the primary object of this work to elicit truth, it will be right to observe that, although the products of analysis be invariable, the *living plant* cannot be said to contain the substances alluded to. Vegetable organized bodies endowed with life, (whatever may be that wondrous essence called the *vital principle*,) are not mere masses of oxygen, hydrogen, and carbon; and their fluids are not solutions of potass, lime, and salts of iron: they are what they appear,—organized structures of wonderful conformation, with the power of absorbing, laborating, and assimilating certain nutritive substances which they derive from the fluids of the soil and air.

Chemistry exerts a legitimate power over dead or inert matter,

and from that, it can abstract those substances which are termed *elementary*; but over the *vital* principle it exerts no control, and of its nature it takes no cognizance. Whenever, therefore, the terms chemical, electro-chemical, or the like, occur in this volume, as applied to the organs or functions of living plants, they are to be viewed as subordinate to the energy of the vital principle. Language fails in points of such deep import, and modesty compels us to avow our ignorance.

“In studying the functions of vegetable being,” says the late Sir James Edward Smith, in his *Introduction*, “we must constantly remember that it is not merely a collection of tubes or vessels holding different fluids, but that it is endowed with life, and consequently able not only to imbibe particular fluids, but to alter their nature according to certain laws; that is, to form peculiar secretions: *this is the exclusive property of a living being*. Animals secrete milk and fat from food which has no resemblance to those substances; so, vegetables secrete gum, sugar, and various resinous substances from the uniform juices of the earth, or perhaps from mere water and air. The most different and discordant fluids, separated only by the finest film or membrane, are kept perfectly distinct while life remains; but no sooner does the vital principle depart, than secretion, as well as the due separation of what has been secreted, are both at an end, and the principle of dissolution reigns absolute.”

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# SECTION I.

## SCIENCE OF GARDENING.

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### PART I.

#### NATURE AND OFFICES OF EARTHS AND SOILS.

1. *Earths and Soils* being the laboratory wherein the food or nutriment of the plant is prepared, and the media through which it is conveyed to the roots; it becomes a matter of primary importance to the gardener and agriculturist, to obtain correct ideas of their component parts, and of the offices which they perform in the work of vegetation. It will also be very useful to acquire a method of *general classification*, so as to arrive at some degree of precision and systematic arrangement: on this subject, says the *Encyclopædia of Gardening*, at No. 1031. 1. “A correct classification of soils may be founded on the presence or absence of organic or inorganic matter in their basis. This will form two grand classes, viz. *primitive soils*, or those composed entirely of inorganic matter; and *secondary soils*, or those composed of organic and inorganic matters in mixture. These classes may be subdivided into *orders*, founded on the presence or absence of saline, metallic, and carbonic matter. The orders may be subdivided into *genera*, founded on the prevailing earths, salts, metals, or carbon; the genera into *species*, founded on their different mixtures; the species into *varieties*, founded on colour and texture; and *subvarieties*, founded on moisture, dryness, richness, lightness, &c.” *In naming the genera*, the first thing is to discover the prevailing earth or earths;—“thus Sir Humphry Davy has observed, the term *sandy soil* should never be applied to any soil that does not contain at least seven-eighths of sand: sandy soils that effervesce with acids should be distinguished by the name of calcareous (chalky) sandy soils, to distinguish them from those that are siliceous,” (of the nature of flint.) “The term *clayey soil* should not be applied to any land which contains less than one-sixth of impalpable earthy matter, not considerably effervescing with acids: the word *loam* should be limited to soils containing at least one-third of impalpable earthy matter, not considerably effervescing with acids.” “In general, the soils, the materials of which are the most various, are those called *alluvial*, or which have been formed from the depositions of rivers; and these deposits may be designated as siliceous, calcareous, or argillaceous (clayey); and in some cases, the term

saline may be added as a specific distinction, applicable, for example, at the mouths of rivers, where their alluvial remains are overflowed by the sea." The word *loam* is in the mouth of every one, yet no term is more vague, and less understood; generally speaking, loams may be said to consist of fine siliceous sand to the extent of, at least, one-half; of aluminous earth—combined with, and coloured by oxide of iron—one-third, more or less; and of a small portion of chalk. These constituents will be particularly described hereafter.

2. *The Qualities and Value of Soils* are discoverable botanically, and by chemical analysis. First, *botanically*, that is, by the plants which grow on them naturally. "The saintfoin (*Medicago sativa*) is almost always an indication of a calcareous soil; the common colt's-foot, (*tussilago-farfara*,) of blue clay; purple sandwort, (*arenaria rubra*,) of poor sand; the common wood-sorrel, (*oxalis acetosella*,) of the presence of iron." Secondly, by *chemical analysis*. The quantity of soil best adapted to a perfect analysis is stated to be four hundred grains: it should be collected in dry weather, and exposed to the air till it become dry to the touch. The process of analysis is complicated, and one of extreme nicety. Some cultivators may be qualified to perform the necessary operations, but in general a degree of accuracy is required which can only be obtained by constant practice, founded upon scientific principles. "The following is the analysis of a fertile soil in the neighbourhood of Bristol; in 400 grains, there were of water, 52; siliceous sand, 240; vegetable fibre, 5; vegetable extract, 3; alumine, 48; magnesia, 2; oxide of iron, 14; calcareous earth, 30; loss, 6." On the utility of analysis Dr. Ure (*Dict. of Chem.*) observes, that "no system can be devised for the improvement of lands independently of experiment; but there are few cases in which the labour of analytic trials will not be amply repaid by the certainty with which they denote the best methods of melioration; and this will particularly happen when the defect of composition is found in the proportions of the primitive earths. In supplying organic matter, a temporary food only is provided for plants, which is in all cases exhausted by means of a certain number of crops; but when a soil is rendered of the best possible constitution and texture with regard to its earthy parts, its fertility may be considered as permanently established. It becomes capable of attracting a very large portion of vegetable nourishment from the atmosphere, and of producing its crops with comparatively little labour and expense."

3. *Of the Uses of Earths.* *Pure earths*, "exclusively of organized matter and water, are considered by most physiologists to be of no other use to plants than that of supporting them, or furnish-

ing a medium by which they may fix themselves" in a situation favourable to their future growth. "But earths and organic matter, that is, *soils*, afford at once, support and food." Thus the *pure earths* may be considered as mechanical agents in the soil. They consist, chiefly, of metallic bases united to oxygen, not readily decomposable; and consequently they cannot be reasonably supposed to be convertible into the elements of organized matter, which, as has been stated, are chiefly found to be oxygen, hydrogen, carbon, and azot. Plants, it is true, consume a small portion of the earths they grow in, as is discoverable by burning, for their ashes are found to contain earths; but the quantity has been ascertained never to equal more than a fiftieth part of the weight of the plant consumed. "The earthy parts of the soil are chiefly useful in detaining water, so as to supply the proper proportions to the roots of the vegetables, and they are likewise efficacious in producing the proper distribution of the animal or vegetable matter." The earths, when duly mixed with such matter, prevent it from decomposing too rapidly, and regulate the supply of its soluble parts in proper proportions to the roots of the plants. The earths are also "necessary to the existence of plants, both as affording them nourishment, and enabling them to fix themselves in such a manner as to obey those laws by which their radicals are kept below the surface, and their leaves exposed to a free atmosphere."

4. *The due tenacity and coherence of the soil* arise from the finely-divided matters of its constituent parts, "and they possess the power of giving those qualities in the highest degree, when they contain much alumina," (pure clay.) "A small quantity of finely-divided matter is sufficient to fit a soil for the production of turnips and barley; and a tolerable crop of turnips has been produced on a soil containing eleven parts out of twelve sand; a much greater proportion of sand, however, always produces absolute sterility." Tenacity is obtained by certain proportions of finely-divided vegetable and animal decomposable matters in union with alumina.

5. *Friability, or looseness of texture*, is chiefly occasioned by the admixture of sand, and in a certain degree, this quality is of importance, "in order that the operations of culture may be readily conducted, that moisture may have free access to the fibres of the roots, that heat may be readily conveyed to them, and evaporation may proceed without obstruction." "As alumina possesses all the properties of adhesiveness in an eminent degree, and silex, those of friability, it is obvious that a mixture of those two earths in suitable proportions, would furnish everything wanted to form the most perfect soil as to water and the operations of cultivation. In a

soil so compounded, water will be presented to the roots by capillary attraction; it will be suspended in it, as in a sponge, in a state of minute division, so that every part may be said to be moist, but not wet."

6. "*The power of soils to absorb water from the air* is much connected with fertility. When this power is great, the plant is supplied with moisture in dry seasons; and the effect of evaporation in the day is counteracted by the absorption of vapour from the atmosphere by the interior parts of the soil during the day, and by both the exterior and interior during the night." "The soils that are most efficient in supplying the plant with water by absorption from the atmosphere, are those in which there is a due admixture of sand, finely-divided clay, and carbonate of lime," (or chalk, which mixture constitutes a loam,) "with some animal and vegetable matter: and which are so light as to be freely penetrated by the atmosphere."

*The productiveness of soils* is influenced by the nature of the sub-soil on which they rest. When they are immediately situated upon a bed of rock, they are rendered dry by evaporation much sooner than when the sub-soil is of clay or marl. "A clayey sub-soil will sometimes be of material advantage to a sandy soil, and will retain moisture so as to be capable of supplying that lost by the earth above." "A sandy or gravelly sub-soil often corrects the imperfection of a too great degree of absorbent power in the true soil. In calcareous countries, where the surface is a species of marl, the soil is often found only a few inches above the limestone, and its fertility is nevertheless unimpaired; though, on a less absorbent soil, this situation would occasion barrenness; and the sandstone and limestone hills in Derbyshire and North Wales may be easily distinguished at a distance, in summer, by the different tints of vegetation. The grass on the sandstone hills usually appears brown and burnt up; that on the limestone hills, flourishing and green."

In the Isle of Thanet, and other districts, where the sub-soil is chalk to a considerable depth, the verdure of the grass, and of young trees and shrubs, is often retained during parching seasons, when in many other situations, the grass is entirely scorched, and the trees lose their leaves, owing to the continuance of dry weather: this was particularly observable in the hot summer of 1818. Chalk absorbs moisture readily, and retains it tenaciously; hence, in hot, dry summers, it gradually affords moisture to the roots of plants at a time when more open and porous soils are comparatively deprived of moisture.

7. *Chemical agency of soils.* Besides the mechanical uses of soil, *there is*, according to Sir Humphry Davy, "another agency between

soils and organizable matters which may be regarded as chemical. The earths, and even the earthy carbonates, have a certain degree of chemical attraction for many of the principles of vegetable and animal substances. The extract from decomposing vegetable matter, when boiled with pipeclay or chalk, forms a combination by which the vegetable matter is rendered more difficult of decomposition and of solution. Pure silica and siliceous sands have little action of this kind; and the soils which contain the most alumina and carbonate of lime, are those which act with the greatest chemical energy in preserving manure. Such soils merit the appellation which is commonly given to them, of rich soils; for the vegetable nourishment is long preserved in them, unless taken up by the organs of plants. Siliceous sands, on the contrary, deserve the term hungry, which is commonly applied to them; for the vegetable and animal matters they contain, not being attracted by the earthy constituent parts of the soil, are more liable to be decomposed by the action of the atmosphere, or carried off from them by water. In most of the black and brown rich vegetable moulds, the earths seem to be in combination with a peculiar extractive matter, afforded during the decomposition of vegetables: this is slowly taken up and attracted from the earths by water, and appears to constitute a prime cause of the fertility of the soil." This extractive matter is identical with the black reduced substance of old dunghills, now called *humus*.

8. *Soils may be improved by pulverization*, or the minute division of the particles by mechanical labour, and under this term are included the operations of ploughing, harrowing, digging, trenching, hoeing, and raking. It is of the most essential service to land, and induces fertility in a variety of ways. It opens the ground, and thus gives scope to the roots of vegetables; increases its sponge-like property, and thus promotes the regular diffusion of water. It tends to increase the quantity of vegetable food, by enabling the water holding nutritive matters in solution, to convey it more equally to the roots of plants. Pulverization, by opening the soil, promotes and assists the free ingress of heated air, and thus regulates and improves the temperature of the soil; it also introduces, and, as it were, buries a considerable portion of atmospheric air, and thus furnishes another source of electro-chemical decompositions and combinations.

"*The depth of pulverization*, Sir Humphry Davy observes, must depend upon the nature of the soil and the sub-soil. In rich clayey ground it can scarcely be too deep; and even in sand, unless the sub-soil contains principles noxious to vegetables, deep comminution should be practised. When the roots are deep, they are less liable to

be injured, either by excess of rain or drought; the radicles are shot forth into every part of the soil, and the space from which the nourishment is derived, is more considerable than when the seed is superficially inserted in the soil." The force of this remark applies strictly to vegetable crops; for as to fruit-trees, a stratum of hard brick-bats, or rocky chips, under a surface soil of turfy loam, not exceeding fourteen inches, would be far more congenial to their roots than a deep bed of prepared, and especially, of *manured* earth.

9. *A free admission of air, and exposure to the influence of heat and cold*, tend to improve the ground. "If the soil be laid up in large lumps (or ridges), it is evident it will acquire more heat, by exposing a greater surface to the atmosphere; and it will retain this heat longer, from the circumstance of the lumps (or ridges) reflecting back the heat radiated by each other. A clayey soil, in this way, it is said (*Farmer's Magazine*, 1815), may be heated to 120 degrees. By the aëration of lands in winter, minute mechanical division is obtained by the freezing of the water in the soil; for as water in the solid state occupies more space than when fluid, the particles of earthy matters, and of decomposing stones, are thus rent asunder, and crumble down into fine mould."

10. *Soils may be improved by adding to, or subtracting from them, ingredients in which they are deficient, or superabound*. If a soil, of good appearance and texture, contain sulphate of iron, it may be ameliorated by quick lime; if there be excess of calcareous matter, it may be improved by the application of sand or clay. Soils too abundant in sand are benefitted by the use of clay, marl, or vegetable matter.

By *burning soils*, considerable chemical changes can be brought about. "The bases of all common soils are mixtures of the primitive earths and oxide of iron; and these earths have a certain degree of attraction for each other." "When clay or tenacious soils are burnt, they are brought nearer to a state analogous to that of sand. In the manufacture of bricks, the general principle is well illustrated: if a piece of dried brick-earth be applied to the tongue, it will adhere to it very strongly, in consequence of its power to absorb water; but after it has been burnt, there will be scarcely any sensible adhesion."

"*The soils improved by burning* are all such as contain too much dead vegetable fibre; also all such as contain their earthy constituents in an impalpable state of division, that is, stiff clays and marls; but coarse sands, or rich soils, containing a just mixture of the earths; and in all cases in which the texture is sufficiently loose, or the organizable matter sufficiently soluble, the progress of burning *cannot* be useful."

## ANALYSIS OF SOILS.

In this place, before we enter upon the consideration of manures and composts, it will be proper to introduce the reader to an acquaintance with the general constituents of native earths; referring him, as standards of comparison, to HENRY'S *Epitome of Experimental Chemistry*, and to DAVY'S *Agricultural Lectures on the subject of Analysis of Soils*. The directions given by these chemists are very instructive, but the tyro will require them to be rendered rather more explicit. I have attempted to do so. The processes now to be described are founded upon the experience of years, simplified improved by much practice.

Chemical research cannot fail to instruct and rationally entertain. As respects the *soil*, it is the only sure guide which may, and ought to be, appealed to by the gardener and farmer in every case of doubt and perplexity; for earths and soils can never be understood, or scientifically meliorated, till their components be discovered and calculated by means which cannot mislead. The various processes will be distinguished by italic letters.

The *apparatus* described by the chemists above named, consists of a balance capable to contain four ounces of the soil, and so finely suspended, as to turn when weighted with a single grain; and a series of weights, from one grain to a pound troy. A nest of brass weights, comprising all the divisions of a pound, from two drachms to eight ounces, is extremely convenient; but, in addition to this, there ought to be duplicates of all the smaller weights, from half a grain to two drachms of the apothecary's table, and a pair of fine money-scales; for it frequently happens that one or more of the products does not exceed a grain or two, and can scarcely be weighed in the larger balance.

A *wire sieve*, sufficiently coarse to admit a peppercorn to pass through it, is mentioned; but as the object is to separate the stones and large fibres from a soil, it would appear better that the apertures of the sieve be so fine as to retain a grain of mustard seed.

An argand lamp and stand, some glass bottles, Hessian crucibles, porcelain and queen's-ware evaporating basins, a Wedgewood pestle and mortar, some filters made of white blotting-paper, folded so as to contain from a quarter of a pint to a pint of liquid, and greased at the edges, two small glass funnels, a bone-knife, and an apparatus for collecting and measuring aëriform fluids (gases), complete the catalogue of vessels and utensils.

I have been somewhat minute in this quotation, in order to

prevent misconception; but the student, unless it be his object to enter into any minute research, will not indispensably require the gas apparatus, or the argand lamp. A temporary furnace may be constructed with two garden-pots, which will supply the place of the latter, and, with some slight modification, it may be applied to keep frost out of a green-house or pit. For chemical experiments, a pot six inches deep, and five inches wide at the rim, is large enough. A small iron grate, or a round plate, perforated with a number of holes to admit air, must be made to drop into the pot, and fit it, two or three inches above the bottom; and under this, two or three air-holes must be made. Another pot, of a size, when inverted, to fit the lower one, by dropping half an inch within its rim, is to have its bottom beaten entirely out. This pot, turned upon the other, will serve as a stand to support a Florence flask, or an evaporating basin. To use the furnace, a little good charcoal is placed on the grate; five or six pieces more, ignited, and red hot, are put upon that, and over those a little more cold charcoal. If the small pot be inverted within the lower one, the charcoal will be speedily kindled. Should the fire be fierce, it will be prudent to employ a stand, with moveable rings, by means of which the vessel to be heated may be raised or depressed; and practice, with discretion, will soon teach the requisite caution. As the fire-pot is liable to crack, it may be secured by one or two iron hoops, or by being bound, in two places, by strong and flexible copper wire.

To reduce and economize the heat of a furnace of this kind, it will only be requisite to cover the upper pot with a slate or flat piece of iron, to a greater or less degree. The rush of air through the holes under the grating will bring the charcoal into a state of *rapid* combustion; but as the gas produced at top is *carbonic acid*,—an elastic fluid wholly inimical to fire,—the combustion will, if its egress be checked, be proportionably abated, or entirely suspended. If, then, two pots of rather larger dimensions be employed, and the upper one be almost filled with charcoal, a fire, diffusing a gentle warmth, may be maintained during a whole night, by nearly closing the upper orifice, and covering the junction of the two rims with a little powdered charcoal. Half a gallon of good, well-burnt charcoal, has been found to keep a house twenty feet long, at nearly forty degrees of heat, the external air being three or four degrees below the freezing point.

The *chemical tests*, or re-agents, which will be required are, muriatic acid (spirits of salts), solution of prussiate of potash, sulphuric acid (oil of vitriol), soap-lye (liquid caustic or pure soda), *solutions of pure ammonia*, of carbonate of ammonia, and of carbo-

nate of potash, or salt of tartar. All, or any of these, can be readily procured of any respectable druggist, and most of them may be prepared, and thus become a source of great pleasure to the intellectual experimenter.

### PROCESSES OF ANALYSIS.

(a) *Preparation of the earth to be examined.*—Let one ounce troy, that is, 480 grains of it, be rendered so dry, by exposure in a saucer to air and sun in summer, or before a fire in winter and damp weather, that it may be easily reduced to powder; when in that state, let it be passed through the sieve, and the siftings weighed. Their weight being noted, they are to be put into a saucer and dried by a heat not less than that of boiling water, for half an hour. The power of absorption and of retention is thus ascertained; and on this subject Davy observed,—“The loss of weight in this process should be carefully noted; and when in 400 grains of soil it reaches fifty grains, the soil may be considered as in the greatest degree absorbent, and retentive of water, and will generally be found to contain a large proportion of aluminous earth. When the loss is only from twenty to ten grains, the land may be considered as only slightly absorbent and retentive, and the siliceous earth as most abundant.”

Whatever be the loss of weight by drying in high temperature, no just estimate can thence be formed of the quality of a soil. I have repeatedly analyzed a loam essentially siliceous, wherein there were very few stones, and little coarse sand: it was highly valuable as a staple soil, of a delicate and velvety texture, and peculiarly adapted to the finer operations of the garden, and in the forcing departments; yet it retained so small a proportion of water that only five and a-half per cent. could be expelled at a high degree of heat.

(b) The coarse stones separated by the sieve, should be weighed, placed in a wine glass, and tested by dropping upon them a little muriatic acid, diluted with its own weight, or measure, of water. If much hissing arise, it will be manifest that they contain carbonate of lime. If no action is perceptible, they consist chiefly of flint, and in that case will be sufficiently hard to scratch glass. The fibrous matters, if considerable, ought to be weighed, and the weight noted down.

(c) *Process of washing to obtain vegetable extract.*—Take 300 grains of the dried pulverized earth, after it has become quite cold, and boil it for ten minutes in four ounces of pure rain water. The vessel should be a small evaporating basin, with a lip. Let the liquor cool, and then decant off as much of the clear fluid as possible.

Pour more water on the earth, stir it, and leave it to subside. Proceed thus till no brown colour be produced, and mix all the washings. These contain the soluble substances of the soil, namely, the vegetable extract, and perhaps some neutral salts. The liquors should be set aside for some time, as a few more particles of floating earth may be deposited; and, in the meantime, the analysis will proceed thus. I wish to avoid filtrations as much as possible; for, be the operator's care what it may, much of the earth will adhere to the paper and be lost; therefore, in the present process, the earth must be permitted to subside till the floating water be quite clear. *That* is to be poured off; and if it be tasteless and void of colour, there can be no occasion for further washing, but the earth may be dried in any warm situation not exposed to dust. It should be rendered quite dry by heat equally strong as that used in process (a), and, after cooling, be weighed. The loss of weight will indicate the quantity of soluble matters taken up by the water; it may amount to five grains, and these will be noticed hereafter.

(d) *Process by Muriatic Acid.* This acid is the great re-agent for the detection and separation of chalk (carbonate of lime). It is customary to direct the separation of the fine matters of the soil by washing them away from the coarser sand which is almost always present; but as it is proved that the latter frequently contains chalk, the loss of time required for a double process is prevented by the simple course which I pursue. First, try the gross soil by applying to a grain of it, a drop or two of the acid let fall from a strip of glass; if the *effervescence be strong*, the quantity of carbonate of lime must be considerable, and in that case, the process recommended by Sir Humphry Davy is very effectual, and at the same time will prove equally instructive. He observes that "Carbonate of lime, in all its stages, contains a determinate proportion of carbonic acid, about 45 per cent. (that is, 45 grains in 100 grains); so that when the quantity of this elastic fluid given out by any soil during the solution of its calcareous matter in an acid, is known, either in weight or measure, the quantity of carbonate of lime may be easily discovered." Put the dry soil into a clean two-ounce phial, having a widish neck. Take another clean phial, and put into it half an ounce of rain-water, and two drachms of strong muriatic acid. Place these two phials in one scale, and balance them accurately by weights in the other scale, so that neither preponderate. Then transfer the diluted acid, by slow degrees, into the phial containing the earth; agitate the phial very gently several times, till the effervescence cease, and replace the empty one: then let the vessels remain undisturbed for an hour. *The difference between the weights before and after the mixture,*

will determine the quantity of carbonate of lime; for as the gas which escapes is *carbonic acid*, and *that* can only exist in the carbonate of lime, the loss will decide the proportion of that constituent: this loss we will estimate at  $6\frac{3}{4}$  grains, and then, 'as  $45 : 100 :: 6\frac{3}{4}$  to 15; that is, according to calculation of Davy, the loss of six grains and three quarters of gas will indicate the presence of fifteen grains of mild calcareous earth in the soil, and this quantity ought to be actually discovered in the course of the analysis. The *lime*, be it remembered, remains dissolved in the diluted acid in the state of *muriate of lime*; for, as that earth has a greater affinity for muriatic acid than for the aërial carbonic acid, it seizes the former, and gives up the latter.

*Muriatic acid* is very cheap: little more than sixpence per pound for an article, the specific gravity of which is from 1.150 to 1.200. It may not be worth while to prepare it, otherwise the process is sufficiently simple, and it is described in HENRY'S *Epitome*.

But muriatic acid dissolves some of the iron which is always present in soils: it may also take up a very small quantity of the alumina, or matter of clay: the iron must be removed from the solution, and this leads us to process *e*.

(*e*) *Prussiate of potash*. This ferro-cyanide of potassium, or ferrocyanate of potash, of modern chemistry, is one of the most delicate tests imaginable for the peroxide of iron, in solutions. It is what is termed a triple salt: it is of a yellow colour, and may be prepared by heating animal matter and potash in an iron vessel; a coaly substance is produced, which is partly soluble in water, and yields the crystallized salt after evaporation. Its constituents are azote, carbon, potassium, iron, and water of crystallization; the iron being in the proportion to the potassium as 28 is to 80. According to Henry, the oxide of iron contained in the salt varies from 24 to 30 per cent. of the whole: this must be borne in mind, when the calculation, which we shall speedily notice, is made.

The analyst can easily prepare this test by dissolving a drachm or two of salt of tartar in one or two ounces of rain-water, bringing the liquor to a boiling heat, and adding powdered Prussian blue, so long as its colour continues to be changed to a foxy brown. The liquor will be of a deep yellow tint, and must be separated from the sediment by filtration through bibulous paper. It must then be evaporated, at a gentle heat in a basin, over a lamp, or slow charcoal fire, till the surface exhibit what is called a pellicle, that is, a slight crystalline film, which shows that the liquid is concentrated, and incapable of retaining all the saline matter in solution. This will

be seen upon cooling; for the yellow crystals will form, and may be collected in twenty-four hours, by pouring off the supernatant liquor. They should be detached by a strip of glass, rinsed with a little of the clear fluid, drained on a paper filtre, then dried gradually and put into a bottle. The foregoing is a digression, but it is not misplaced; for it will prepare the way towards a knowledge of the rationale of the process soon to be now described.

The liquor in the phial consists of water, holding in solution muriate of lime, muriate of iron, and an excess of acid which should render it quite sour to the taste. If it be not so, more strong acid must be dropped in. Prepare a filtre, by cutting a piece of white blotting-paper six or seven inches square, and fold it twice from corner to corner: round these off, and grease the edges. Dry the filter perfectly, weigh it accurately; then place it in a glass funnel. The paper should be substantial, or a double filtre should be employed, one within the other, the single fold of the inner one being placed against the triple fold of the outer one. Filtres of this size will be generally large enough for any of the products of an analysis on the scale now under consideration.

Pour off as much as possible of the clear liquor in the phial into a tumbler-glass; then add to the earth an ounce or more of rain-water; agitate the phial, and pour the contents into the filtre. The first runnings will be a little turbid; they therefore should be received in a glass, or lipped basin, and returned to the funnel. Rinse the phial, so as not to leave a particle in it; pour the rinsings on the earth, and continue to add water, till no acid taste be discoverable; then add the washings to the original liquor.

The earth in the filtre being dried upon it, first by absorption on a piece of clean blotting paper, laid over a smooth lump of chalk, and finally by a gentle heat, is to be weighed: the loss of weight after drying, and subtracting the tare of the filter, will denote the quantity of matters dissolved by the action of the muriatic acid. Dissolve about forty grains of the prussiate of potash in rain, or distilled, water, sufficient to take it up; and ascertain the exact quantity of the solution by a graduated measure-glass. Suppose it amounts to four fluid drachms, then, one drachm will contain ten grains of the salt. Pour that quantity into the solution, and a copious precipitate of blue will occur; stir the fluid with a strip of glass; and leave the contents to settle. Try it with a drop or two more of the test, and continue the additions till no more Prussian blue fall. This substance is a *prussiate of iron*, for the salt becomes decomposed by double chemical affinity; the iron in the solution unites with the cyanide of iron of the test, and is precipitated in the

state of Prussian blue, while the muriatic acid which was united with the iron, attracts the potassa of the test and produces a liquid *muriate of potass*. The solution is thus deprived of its iron, while the iron contained in the test is carried down in conjunction with it; but a little of the blue becomes dissolved.

A second filtre is to be prepared, greased, and weighed; and upon it, the blue with its liquor must be cautiously poured. The same care in returning the turbid droppings into the filtre, and inedulcorating the substance upon it, must again be observed. All the fluids are to be mixed together. The blue when drained is to be left in its filtre, and dried; then set aside for another process. The treatment of the fluid just alluded to will be described after the process of

(f) *Separating the earths*. These being deprived of their chalk, magnesia, if any, and a portion of their iron; and being dried and weighed as directed, are to be forcibly agitated with water, repeatedly added. After each portion, the coarser matter, which is chiefly sand, must be permitted to subside. This it will do in a few seconds, leaving the finely divided substances floating. By decanting the turbid water, those fine substances will, in the course of five minutes, be washed off from the sand. They are to be collected, and permitted to subside; when the clear water can be poured off, and the substances dried without the loss of one grain. But care will be required in the manipulation; and if the reader attend to the foregoing minute directions, he will acquire an adroitness which will prove extremely useful in all future chemical experiments.

The two portions of the soil thus separated, must be made perfectly dry, and their weights read off. It is not essential at this stage to wash off the fine substances with any view to chemical accuracy. In fact, chemists direct the separation to be made before the application of muriatic acid; for which, no other reason, it appears to me, can be assigned, than to economize the acid. By the operation of the muriatic acid, the entire mass has been deprived of its chalk, and it is rational to treat it for *alumine* also; for the coarser portion of sand may contain its share of that earth: I therefore leave the course of the future analysis open to the judgment of the reader.

(g) *Process to separate the carbonate of lime*. Into the muriatic solution, deprived of oxide of iron, a solution of carbonate of potassa (made by dissolving salt of tartar in the way directed for the preparation of the prussiate of potash, and filtrated) must be dropped till effervescence cease; the fluid being frequently stirred. A change of appearance will be remarked. At first, the bubbles will rise

freely: by degrees the clear blueish tinge will pass away, and be succeeded by a dingy green, the bubbles increasing in quantity, and forming a heavy froth. A neutral condition will thus be indicated, and then, the addition of a few more drops of the solution will cause the separation of white masses, not dissimilar to those of soap, curdled by hard water. When a slight excess of alkali is present, it will be discovered by a peculiar taste and smell which cannot be mistaken; but the young chemist should, in his early experiments, be provided with test-papers made by dipping strips of blotting-paper into solutions of turmeric and turnsole (litmus). Any slight excess of alkali will convert the yellow tint of the turmeric into a dingy red.

The reader will recollect that by process (a), the loss of weight was made a criterion of the quantity of *carbonate of lime* existing in the soil. The precipitate now produced, being collected in a weighed filtre, washed till free from taste, and weighed, ought to prove the accuracy of the calculation; for its weight should correspond very nearly with that of the estimate so obtained. A little magnesia may however be present; and therefore to render this point certain or otherwise, the fluid, and washings of the chalk should be boiled in a flask for twenty minutes, in order to expel some of the loose carbonic acid gas they may contain, and which would retain magnesia. If any quantity of that earth be present, it will, according to Davy, be precipitated, and its quantity can then readily be ascertained; but its detection will be secured by precipitating the chalk with perfect carbonate of *ammonia* in solution, in lieu of carbonate of *potassa*. It will throw down the chalk, and whatever *alumina* may, by possibility, be present. The clear liquor which passes the filtre as before, being boiled, a little of the solution of pure ammonia (*liquor ammoniæ fortis* of the shops) should be added. If any precipitation occur, it may be considered *magnesia*.

(h) To ascertain the quantity of vegetable and animal substances, heat the remaining earth in a crucible to redness: the charcoal furnace will answer the purpose completely. Stir the soil repeatedly with an iron rod, and continue the heat till no blackness remain. The decomposable substances become carbonized; and if *animal* matter be present, the fetid odour will indicate its existence. The loss of weight after the total removal of decomposable matter will show the quantity of it which the earth contained. During this process the remaining earth will assume a reddish colour in consequence of the higher oxygenation of the remaining iron.

(i) The process for the separation of *alumina*, or the fine matter

of clay, stands next in order, and requires much accuracy. Dry alumine is extremely difficult of solution, as any one may convince himself by attempting to act upon a little pipe clay, either by acids or alkalies.

The alumina in a soil may, however, be generally removed by one or both of the following processes; the first is described in Davy's own words. "The earth should be boiled for two or three hours with sulphuric acid, diluted with four times its weight of water; the quantity of acid should be regulated by the quantity of solid residuum to be acted on, allowing for every hundred grains, two drachms, or one hundred and twenty grains of acid."

I have tried this process repeatedly, and always found some chalk present: it was perhaps a product of the calcination, produced, by the decomposition of pure vegetable substances. To act with certainty, therefore, let three grains of *salt of tartar*, for every sixty grains of the earth, be added to it, then one fluid drachm of rain-water, and as much concentrated sulphuric acid: these proportions are definite, and easy of calculation. Expose the substances, mixed in *the order* described, to a gentle fire, in a flask with a rather wide and short neck, and bring to the heat of  $212^{\circ}$ , and let them simmer to dryness. Remove the flask from the heat, and when cool, add a similar quantity of sulphuric acid equally diluted: repeat the slow boiling till the earth appears dry, and then remove the flask. The alumine will thus be converted into a sulphate of alumine and potassa, easily soluble in rain or distilled water, one ounce of which should be added; after which the substances should be heated gradually to the boiling point, the flask being occasionally shaken to raise the earth from the bottom. When cooled, pour the contents of the flask on a weighed filtre, and wash off the acid, mixing the drainings. Nothing now will remain but fine silicious earth; and this must be dried and weighed. The fluid will contain some oxide of iron, and all the alumine, with possibly, a little carbonate of lime, for gypsum (sulphate of lime) may have existed in the soil.

(*k*) *The separation of the iron.* Dr. Henry and Sir Humphry Davy do not employ the Prussian test on this occasion; it is observed that the alumine and iron "may be separated by carbonate of ammonia, added to excess: it throws down the alumine, and leaves the oxide of iron, and this *substance may be separated from the liquid by boiling.*" Subsequently, Sir Humphry Davy directed the *succinate of ammonia* as the re-agent for the separation of the iron. There can be no question of its efficiency; but who can procure, or prepare it? Upon the whole, the *ferro-cyanide of potassium* is to be preferred; it may be depended on, and I always use it. It should be applied

as before, the quantity of solution being noted down. See (e), and when it ceases to cause precipitation, the substances must be placed in a filtre, to detain the Prussian blue; the same filtre which was used for the separation of the first quantity may be employed, if it be sound; for, if the weight of the test have been accurately noted on each occasion, the proportion used will be ascertained. The blue must be completelyedulcorated, as before.

It frequently happens that a strong blue tinge is seen in the filtrated fluid. In that case it is to be gently boiled for a few minutes, when some particles of blue will separate, and the liquid will percolate nearly free from colour.

The Prussian blue on the filtre should be weighed, but not noted as a product, because it did not exist, in that condition, in the soil. The oxide of iron which it contains must be discovered, and for this purpose chemists direct the calcination of the *blue* at a red heat, to destroy the prussic acid, and leave the oxide; but a far more easy and economical process may be adopted.

Place the filtre in a glass funnel, and pour into it a weak solution of pure, or caustic potash, in quantity sufficient to come in contact with every part of the blue on the paper. The solution should be heated to  $130^{\circ}$ , and then its effects will be instantaneous; the blue tinge will vanish, and be succeeded by a russet brown. A vessel should receive the filtrated liquor, which is a weak solution of prussiate of potash, with excess of alkali. The first runnings should be saved for a repetition of the process on future occasions; for as long as any alkali superabounds in it, it will decompose prussian blue; and finally, by evaporation, may be made to yield crystals of *ferro-cyanide of potassium*. Pour water into the filtre till no saline taste remains, and dry the oxide of iron, the weight of which must be ascertained in the way before described. But as it also is cumbered with the iron of the test, a correction is required. Thus, supposing the quantity of the prussiate used in the two precipitations to be 20 grains, allow 5 grains for the oxide of iron in it, as an approximation to the exact quantity. Subtract that quantity from the weight of the oxide on the paper, and the product will be the weight of the iron which existed in the soil.

If any one attempt to detach the blue from the filter in order to calcine it, he will soon perceive how vain will be the attempt, so intimately does it incorporate itself with the paper.

(l) *To separate the alumina* from the solution thus deprived of iron, add alternate portions of *caustic soda* (soap ley), and carbonate of ammonia, both in solution, till effervescence cease. Potass is to me objectionable, because it forms, with sulphuric acid, a salt diff-

cult of solution; and as that acid has been used in great excess, sulphate of potassa may be precipitated. Sulphate of soda and ammonia, which will result from the solutions above directed, are more soluble salts, and therefore will not mislead. Let the alkali be added to some excess, then filtrate the liquor, wash the contents, dry and weigh them, first with their filtre, and again when separated from it. The comparison will be instructive, as it will prove how difficult it is to collect the whole of a product.

The filtrated strong liquid should be boiled to cause the separation of more earthy matter.

The precipitate may be considered *alumine*, but it should not be taken for such on trust; it may, and probably will, contain some *carbonate of lime*; it therefore must be analyzed. We have stated that *dry alumine* is very difficult of solution; if, therefore, after drying, a minute drop of acid applied to a small portion of the alumine produce effervescence, some earthy carbonate is present. To detect chalk (*carbonate of lime*), add diluted muriatic acid, *cold*, till visible action cease, but not to excess. Let the remaining earth subside, place a drop of the fluid on a watch-glass, and apply to it a little solution of oxalate of ammonia on the end of a strip of glass. Any turbidity or milkiness will indicate that oxalate of lime is formed. In that case, strain off the fluid, add solution of carbonate of ammonia, to precipitate the chalk; bring the clear liquor to boiling heat, drop in it some solution of pure ammonia, and let it simmer for some minutes. If turbidity and precipitation occur, the presence of *magnesia* is proved.

(*m*) The *saline and extractive substances* dissolved in the first water of lixiviation remain to be examined. The fluid is to be slowly evaporated, and if any crystalline pellicle be seen during the evaporation, the vessel should be set aside to cool; if not, the process must be carried on to dryness. A brown colour will indicate vegetable, and perhaps animal, matter; the latter will be discovered by a fetid odour on applying a strong heat. But *saline* compounds frequently exist, such as muriate of soda or potash, nitrate or sulphate of potash, or of lime. If crystals can be obtained, the salts may be easily examined by dissolving them in a very little water. Any *saline muriate* will yield a precipitate on applying a minute drop of solution of nitrate of silver. A nitrous salt can be tested either by touching a particle of it with pure sulphuric acid, when fumes of nitrous acid gas will be evolved, or by placing it on an ignited coal or charcoal, when it will be decomposed, and produce brilliant combustion of the carbon. If no crystals be present, the salts are either absent or in small quantity.

The analysis is so far complete, and little will remain but to collect the products, and note them down in their order. The annexed table contains the results of an accurate experiment with a loam of excellent quality:

240 grains tested, yielded, of coarse sand . . . . .	81 gr.
The fine substances produced	
by muriatic acid—see processes (d), (g),—chalk . . . . .	6 gr.
by sulphuric acid—processes (i), (l),—alumina, with a hint of carbonate of lime . . . . .	17½
Blue precipitated by 33 grains of ferro-cyanide of potassium, produced, after allowing 8 grains, oxide of iron, (e, k), . . . . .	9
Vegetable extractive from lixiviation—process (m) . . . . .	2
Loss by fire—process (h) . . . . .	18
Fine silex, the final residuum of process (i) . . . . .	100
	— 152½
Loss by filtrations, &c. . . . .	6½
	— 240

Nothing is said in the foregoing table of several substances noticed by chemists; but such were not suspected to exist, and none appeared. It is notorious, however, that sulphate of lime (gypsum) frequently is present, and the process given by Sir H. Davy may detect it, as it will convert the *sulphate* into a *sulphuret* of lime, by abstracting the oxygen from its sulphuric acid.

A given weight of the entire soil (200 to 400 grains) must be heated red, for half an hour, in a crucible, mixed with one-third of powdered charcoal. The mixture must then be boiled for a quarter of an hour, in a half pint of water, and the fluid passed through a filtre, and exposed for some days to the atmosphere in an open vessel. If any quantity of sulphate of lime (gypsum) existed in the soil, a white precipitate will gradually form in the fluid, and the weight will indicate the proportion. Such is the substance of the process alluded to, and it is worthy of observation.

I cannot conclude this somewhat prolix article more instructively, than by again referring to the great departed chemist; his remarks are very encouraging.

“When the experimenter is become acquainted with the different instruments, the properties of the re-agents, and the relations between the external and chemical qualities of soils, he will seldom find it necessary to perform, in any one case, all the processes that have been described. When the soil, for instance, contains no notable portion of calcareous matter, the action of muriatic acid may be omitted. In examining peat soils, he will principally have to attend to the operation by fire and air (h); and in the analysis of

chalks and loams, he will be often able to omit the experiment by sulphuric acid.

“In the first trials that are made by persons unacquainted with chemistry, they must not expect much precision of result. Many difficulties will be met with; but in overcoming them, the most useful kind of practical knowledge will be obtained; and nothing is so instructive in experimental science as the detection of mistakes.

“The correct analyst ought to be well grounded in general chemical information; but, perhaps, there is no better mode of gaining it than that of attempting original investigation. In pursuing his experiments, he will be continually obliged to learn from books the history of the substances he is employing, or acting upon; and his theoretical ideas will be more valuable in being connected with practical operation, and acquired for the purpose of discovery.”  
—DAVY’S *Analysis of Soils*.

## PART II.

### OF MANURES AND COMPOSTS.

11. *The pure or simple earths alone*, (it has been stated,) do not perform any direct part in the process of vegetable nutrition; they may be considered as the media by which the plant is supported, and through which it is enabled to supply itself with the aliment necessary to the growth and developement of its parts.

That aliment appears to be furnished either by decayed vegetation, naturally, (i. e. by absorption of the products of natural fermentation, either from the surface of the ground, or floating in the atmosphere,) or artificially, and chiefly by the organic materials applied by labour. The earths, so supplied with organic matter, are called *soils*, and are said to be manured; and it now remains to examine the nature and composition of various composts, which experience has proved to possess properties fitted to recruit the soil with matter, of which it has been deprived by the crops it has borne.”

12. “*Vegetable and animal substances* deposited in the *soil*, as is shown by universal experience, are consumed during the process of vegetation; and they can only nourish the plant by affording solid matters capable of being dissolved by water, or gaseous substances capable of being absorbed by the fluids in the leaves of vegetables. *Mucilaginous, gelatinous, saccharine, oily, and extractive fluids, carbonic acid and water*, are substances that, in their unchanged states, contain almost all the principles necessary for the life of plants;

but there are few cases in which they can be applied as manures in their pure forms; and vegetable manures, in general, contain a great excess of fibrous and insoluble matter, which must undergo chemical changes before they can become the food of plants." "If any fresh vegetable matter which contains sugar, mucilage, starch, or other vegetable compounds, soluble in water, be moistened, and exposed to the air, at a temperature from  $55^{\circ}$  to  $80^{\circ}$ , oxygen will soon be absorbed, and carbonic acid formed; heat will be produced, and elastic fluids, principally carbonic acid, gaseous oxyde of carbon, and hydrocarbonic gas, will be evolved: a dark coloured liquid, of a sour or bitter taste, will likewise be formed; and if the process be suffered to continue for a time sufficiently long, nothing solid will remain, except earthy and saline matter, coloured black by charcoal."

"*Animal matters* in general are more liable to decompose than vegetable substances; oxygen is absorbed, and carbonic acid and ammonia formed in the process of their putrefaction. They produce fetid, compound, elastic fluids, and likewise azote: they afford dark-coloured acid and oily fluids, and leave a residuum of salts and earths mixed with carbonaceous matter. The principal animal substances which constitute their different parts, or which are found in their blood, their secretions, or their excrements, are gelatine, fibrine, mucus, fatty or oily matter, albumen, urea, uric acid, and other acids, saline and earthy matters."

"Whenever manures consist principally of matter soluble in water, their fermentation and putrefaction should be prevented as much as possible. To prevent manures from decomposing, they should be preserved dry, and kept as cool as possible."

13. *Vegetable substances convertible into manures*, embrace a vast variety of articles too numerous to be detailed; among these are green succulent plants, and weeds of every description, and sea weed. These ought to be dugged into the ground as soon after their death as possible, as, if exposed to the air, they readily ferment, and consume almost to nothing. Green crops, pond weeds, and parings of hedges and ditches, or any kind of fresh vegetables, require no preparation to fit them for manure; but dry straw, spoiled hay, and other dry vegetable matter, should be broken up by previous fermentation, as should moist woody fibre, peat, and tanner's bark. *Tanner's-bark* particularly demands notice, as it has been deemed useless, if not injurious to land, and consequently has become a burdensome stock to the tanner, owing to its rapid accumulation. On this subject, I quote the following authorities from London: *Arthur Young* attributes the deleterious effects of bark to the "astrin-

gent matters which it contains." "Lord Meadowbank has judiciously recommended a mixture of common farm-yard dung, in the proportion of one part to three or four of peat;" and tanner's-bark "will probably require as much dung to bring it to fermentation as the worst kind of peat. It is evident, from the analysis of woody fibre, by Gay Lussac and Thenard, (which shows that it consists principally of the elements of water, and of carbon, the carbon being in a larger proportion than in other vegetable compounds,) that any process which tends to abstract carbonaceous matter from it, must bring it nearer in composition to the soluble principles; and this is done in fermentation by the absorption of oxygen, and production of carbonic acid:" a similar effect is produced also by quick-lime, as will be shown at No. 18 of this section.

14. *Manures of animal origin* are supposed to require but little or no chemical preparation; they may be introduced at once into the soil: the great object is to blend them with the earths equally, and perfectly, so as to prevent too rapid a decomposition. Among the animal substances, are muscular flesh, fish, bones reduced to fine powder, hair, woollen rags, feathers, blood, urine, dung of cattle, &c., night soil, and soot. But the great mass of manures is procured from the stable or farm-yard, where the excrements of horses, cattle, swine, and poultry, are blended indiscriminately with straw and every kind of litter. Soot is principally formed from the combustion of coal, and contains substances derived from animal matters. "It is a very powerful manure; it affords ammoniacal salts by distillation, and yields a brown extract to hot water, of a bitter taste; it likewise contains an empyreumatic oil. Its great basis is charcoal, in a state in which it is capable of being rendered soluble by the action of oxygen and water. This manure is well fitted to be used in a dry state, thrown into the ground with the seed, and requires no preparation." Soot is also inimical to vermin, and sometimes is useful in preventing the ravages of the insects which attack young turnips, carrots, &c.

15. *Of the fermentation of vegetable and animal manures.* A slight fermentation is of decided utility: heretofore an idea has prevailed that the fermentation of the dung-heap should be carried on to the extent of reducing the mass to the state of short, or spit-dung, in which it may readily be cut with the spade; but during this protracted fermentation, much valuable matter is lost, the mass becomes cold, and is reduced probably to one-half; and many of its gaseous products are driven off, which would prove of essential service to the processes of vegetation if they were retained in the soil.

Sir H. Davy ascertained this by actual experiment, in October, 1808. He filled a three-pint retort with fermenting litter and dung of cattle, and adapted a tubulated receiver to it, connecting the latter with a mercurial pneumatic trough and apparatus, wherein to collect the elastic gaseous products. The receiver soon became covered with drops of liquor, which gradually trickled down its sides. In three days, thirty-five cubic inches of gas had also passed over into the pneumatic apparatus, and were found to consist of twenty-one inches of acid gas, and fourteen inches of hydro-carbonate, or carbonated hydrogen gas, mixed with a small portion of azotic gas. The fluid in the receiver amounted to nearly half an ounce; it had a saline taste, and a disagreeable smell, and contained acetate and carbonate of ammonia. In another experiment, he filled a retort with dung of a similar sort, very hot, and inserted its beak among the roots of a grass border in the garden. In less than a week the grass, whose roots were exposed to the influence of the matter disengaged by the fermentation, grew with more luxuriance than the grass in any other part of the garden.

16. *Extreme and protracted fermentation is injurious to manures*, not only by occasioning the dissipation of gaseous matters, which the experiments above recited demonstrate to be of great utility to vegetation, but by “the loss of heat, which, if excited in the soil, is useful in promoting the germination of the seed, and in assisting the plant in the first stages of its growth. Again, it is a general principle in chemistry, that in all cases of decomposition, substances combine much more readily at the moment of their disengagement, than after they have been perfectly formed;—and in fermentation beneath the soil, the fluid matter produced is applied instantly, even while it is warm, to the organs of the plant, and, consequently, is more likely to be efficient, than in manure that has gone through the process.” It may then be rationally concluded, that although fermentation should be carried on in the dunghill, till it break up and reduce the mass of *fibrous matters*, so as to render them more manageable, yet the process should not by any means be pushed on beyond that point. “It may even be questioned, whether it would not be better to have no fermentation at all, than to suffer it to be carried on, to the total decomposition of the various matters employed, and the dissipation of the gaseous products.”

17. There has been some misconception on the subject of unfermented manure. Mr. Coke did not find it answer; of this I hold incontestible proof in a letter received from him some years ago. All manure applied to gardens ought to be in the reduced state of *spit-dung*, unless it be buried deeply in trenches, or used as mulch

around the boles of trees, &c., when long litter and semi-decayed leaves are not objectionable.

18. *Manures of a mineral origin.* These are chiefly *lime* and its compounds—and *muriate of soda*, or *common salt*. Quick-lime is made by strongly heating limestone, or chalk, in kilns; by which process, the carbonic acid they contain is driven off. The lime then becomes caustic, “and when mixed with any moist, fibrous, vegetable matter, a strong action is excited between the two substances, and they form a kind of compost, of which a part is soluble in water. By this kind of operation, lime renders matter nutritive, which was before comparatively inert.” “*Slacked lime* is merely a combination of lime with about one-third of its weight of water, and is called by chemists, *hydrate of lime*.” *Mild-lime*, or chalk, is lime in union with carbonic acid, and is termed carbonate of lime; according to Davy it has no action on inert vegetable matter, and will only improve the *texture* of the soil. Mr. Ruffin of the U.S. has, however, shown that it becomes a prime agent of fertility, in all lands wherein vegetable acids abound: America affords a striking proof of this: (see Ruffin on *Calcareous Manures*). *Quick-lime* should be applied when the land abounds with vegetable fibre; and likewise to induce the decomposition of tanner’s bark, saw-dust, and peat; when, if employed in the proportion of one-fifth of the inert substances, it is always efficacious. It is also highly recommended as an effectual application to soil that is *foul*, or infested with “the grub.” “All soils are improved by mild lime, and ultimately by quick-lime, which does not effervesce with acids; and sands more than clays. When a soil, deficient in calcareous matter, contains much soluble vegetable manure, the application of quick-lime should always be avoided, as it tends to decompose the soluble matters by uniting to their carbon and oxygen, so as to become mild lime;” or it forms new compounds, having less attraction for water than the pure vegetable substances. “Lime should never be applied with animal manures, unless they are too rich; or for preventing noxious effluvia.”

*Quick-lime promotes fermentation:* that is, by its strong affinity for the water contained in such inert substances as tanner’s-bark, for instance, it first seizes upon that water, or rather upon its elements: it also, by an electro-chemical action, decomposes the vegetable substances themselves, and produces new arrangement of their elements; and, as carbon and oxygen abound in such substances, it becomes *mild lime*, by uniting with the carbonic acid which is formed by the union of oxygen with part of their carbon, while the remaining part of that carbon is deposited in the form of charcoal.

*Gypsum* (sulphate of lime) has been used with great success in America; and with advantage in some parts of Kent. It may be found useful in the culture of saintfoin, and other artificial grasses, but appears to be of little value to the gardener.

*Common salt* has, of late years, been repeatedly recommended as a valuable manure. "It consists of the metal *sodium*, combined with chlorine, formerly termed 'oxymuriatic acid.' Sir John Pringle has stated, that salt in small quantities assists the decomposition of animal and vegetable matters." It attracts and retains moisture, is offensive to insects, and is, doubtless, found in some plants. When used in large quantities, it is apt to render land barren; but the abuse is no argument against the proper use of common salt. It has been frequently used in a small garden, the soil of which was little else originally than road-sand (from stone containing calcareous matter), and saw-dust, for two or three years successively. It was lightly sprinkled, or sown over the beds, to the extent of about fourteen pounds on three perches of ground, at the time of cropping; and good-tasted cabbages, broccoli, and potatoes, were subsequently produced. Still, however, its properties require to be tested by many well-observed experiments on soils of various qualities; and, till this be done, the real value of salt, as a manure, must continue to be doubtful.

After all that has been said of salt as a manure, we have no undoubted evidence of its utility. It may act as a *stimulant* or *solvent*; but we do not appreciate the terms. To enable it to dissolve manure it must be decomposed, and then its base, *soda*, will be the agent; therefore, common soda will be a more ready and efficient application. But nature does not require solvents, nor does a plant absorb liquid manures. Salt unquestionably kills earth-worms; but will not affect grubs; the larva of that pest, *Ægrotis segetum* will live in salt.

19. From all that has been advanced, *the conclusions naturally to be drawn* are, first,—That as vegetables are found to be resolvable into the elements, carbon or charcoal, oxygen, hydrogen, and, in some cases, a small portion of azote, they must require for their food such substances as are capable of producing the like elements: secondly,—that vegetable and animal substances, when subjected to fermentation, furnish solid, fluid, and gaseous matters containing these elements, which, when blended with the earths, are distributed to the roots of the plants, are converted into sap, and in that state taken up by their vascular system: thirdly,—that various saline and earthy matters are also found in plants; and these must be supplied by mineral substances existent in, or superadded to the soil; from which, they too, are absorbed by the vessels of the plant.

Thus it appears, that chemical action, and the functions of vegetable life, are antagonist, the one to the other; and thus the principle laid down in the preliminary observations is made good; viz., that *chemical action* decomposes the parts of the vegetable being, and forms compounds qualified to become the food of plants; and *vegetable vitality*, in its turn, seizes upon the products of chemical action, and appropriates them to the formation and growth of the parts and organs which constitute the vegetable organized being.

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## SECTION II.

### NATURAL HISTORY AND CULTIVATION OF ESCULENT VEGETABLES OF THE LEGUMINOUS TRIBE.

#### PART I.

Subject 1. THE GARDEN BEAN :—*Vicia Faba*. *Leguminosæ*, X VII.  
Class xvi., and Order iv., *Diadelphia Decandria*, of Linnæus.

20. *The Bean* is a hardy annual, rising from two to four feet high, having thick angular stalks, with alternately pinnated, rather glaucous leaves. The flowers are papilionaceous; the colour, mostly white, or with a tint of blue, and a black spot on the alæ or wings, succeeded by erect pods, woolly within, and containing a row of compressed seeds. The blossoms are highly fragrant, the odour resembling that of the orange-flower, blended with cinnamon. “The Bean,” says Loudon, (No. 3612,) “is a native of the East, and of Egypt, and it has been known in the country from time immemorial, having, probably, been introduced by the Romans. The seed of the bean offers to the student of vegetable physiology, one of the most ready and familiar illustrations of the structure of a dicotyledonous seed: as an example, the reader is referred to the wood-cut and accompanying description given in June. Art. *Testa*.”

21. There are above fifteen *varieties* cultivated in these islands, of which the six following are selected as appropriate to gardens of moderate dimensions:—one or two are sufficient for small gardens.

Early Mazagan,  
Early long-pod,

Toker,  
Broad Spanish,

Sandwich,  
Broad Windsor.

The first is hardy, and the best flavoured of the early sorts: the Long-pod, the Toker, and Spanish, are good bearers, and they may succeed the two former. The Sandwich has long been approved for fruitfulness, and the Windsor for flavour, but it is not quite so

prolific. The Windsor and Long-pod appear to hybridize to the advantage of both, as respects flavour and productiveness.

22. *Cultivation.* The Mazagan for early crops may be sown in October, November, December, and January, in a warm border facing the full sun; but the most certain method of proceeding, is to select a small spot in the warmest border, about the extent of a two-light hot-bed frame, and sloping a little to the south. Work the ground till it become quite fine, then rake off about three inches of the surface, and sow the beans an inch apart every way. Cover them equally with fine earth to the depth of three inches, and at the approach of, and during frost, protect the bed either with a frame and lights, by a covering of mats supported on sticks, or by leaves of fern. Give air, and remove the covering when the weather has been for some days mild; and in February or March, as soon as it appears somewhat settled, dig and manure the ground intended for the beans, and transplant them into small drills two inches deep and three inches apart, the rows being two feet asunder. Care should be taken to ease the beans out of the seed bed, with as much earth as possible adhering to the roots, and to place them evenly in the drills; then lay the earth pretty high about the stems. Let the spot of ground be as much as possible sheltered from cutting winds, and protect the young plants in very severe weather by evergreen boughs or leaves of fern. *Transplanting* is believed to accelerate the fruiting of beans by a week or more: some recommend the practice of pulling off the old bean at the time of moving the beans, and then, pruning off the end of the tap root; but the practice cannot be justified, as the *cotyledons* of the seed are the organs of nutriment to the young plant during its early progress. Some gardeners make a practice of transplanting all the bean crops from seed beds; and it is certain that seed beds can at all times be readily protected by coverings in hard weather.

23. *For main summer crops,* sow the Toker, Spanish, Sandwich, and Windsor beans; or *Windsor* and the *long-pod*, the seeds placed alternately in the drills to promote the hybridization of the two varieties. Let the rows be three or four feet asunder, and the beans four or five inches apart. Abercrombie says, "for the large beans, you should always choose the most open situation. Dibble the holes all of equal depth, and strike the earth upon them with the dibber as you go on." It may be questioned, whether it be not in all cases the better way, where the garden will admit of it, to set the beans in long single rows, or at the most, in never more than two rows adjoining. The rows, when numerous, take up more room, and the beans crowd and draw up each other into long *unsightly haulm*, which is very liable to be injured by winds and

heavy rain. In sowing the beans, place them at regular distances, in drills; draw the earth over them, and press it down with the spade; then rake the ground, so as to leave a perfectly smooth surface. Cobbett, in his *English Gardener*, says, the earth on the drills should be “trodden down with the whole weight of the body of a stout man; for the more closely they are pressed into the ground, and the ground is pressed on them, the more certainly and the more vigorously will they grow; and the more difficult, too, will it be for the mice to displace them.” (Number 123.)

*Succession crops* are obtained by planting at periods of about three or four weeks apart, from the last week in January to the beginning of June. The early autumnal sowings require, as has been said, a warm sheltered border, and a sunny situation, sometimes a covering; but these succession spring sowings should have a moister situation, and more full exposure in the garden. “Try, also,” says Abercrombie, “a late planting in July of the white blossom and mazagan, in a strong moist situation: they will sometimes furnish a supply towards Michaelmas.”

*Beans prefer a rich and rather moist soil*, but will prosper fairly in most common soils.

*Subsequent culture.* As the beans advance in growth, draw earth to the stems, and keep the ground clear from weeds; commence this work when the beans are five or six inches high, and repeat it once or twice. When the beans are in full blossom, and the stalks grow tall and rank, particularly in very wet seasons, nip off the tops of the stalks. Most gardeners are of opinion that topping improves the crops in quality and quantity. The aphid, or black insect, but too frequently covers the upper part of the stems. Topping is, I believe, found to be pretty effectual, not only as a preventive, but in curing the disease when it does not extend below the upper blossoms.

*The quantity of seed* for early crops is estimated at one pint for eighty feet of row: for the main crops a less quantity may suffice, as the larger beans are to be set further apart.

Subject 2. PEA:—*Pisum Sativum*. Leguminosæ. Class xvii. and Order iv. *Diadelphia Decandria*, of Linnæus.

24. *The Pea* is a hardy annual, native of the south of Europe, and has long been cultivated. “It was not common, however, in Elizabeth’s time, as Fuller informs us that peas were brought from Holland, and were ‘fit dainties for ladies, they came so far and cost so dear.’” (Loudon, 3597.) The pea is a climber, has pinnated tendrilled leaves, and produces papilionaceous flowers, on footstalks,

from the axils of the leaves, which are succeeded by pods, usually in pairs, containing the seeds,—the part of the plant used as food. There is one exception in the variety called the sugar-pea, in which the tough membrane, or parchment of the pea, is wanting. This sort is sometimes boiled whole, and eaten as kidney-beans, or it is made into a pickle.

*The varieties* of peas are very numerous: Loudon (Number 3599,) enumerates twenty-three; but seven principal sorts may be cultivated with advantage, if there be sufficient space of ground to admit of succession crops:—viz.

*Early white Warwick*, a new, highly-flavoured variety, suitable to field or garden culture.

*Early frame*, an early and excellent bearer.

*Early Charlton*, equally suitable to late as to early crops.

*Blue Prussian*, a prolific, superior pea, for the middle crops.

*Blue Imperial*: the *dwarf* is a fine rich pea, and does not attain much more than a yard in height; all the Imperials produce rich, pulpy peas.

*Knight's marrowfat*, of tall luxuriant growth, very rich in flavour, and a fine bearer.

*Spanish dwarf*, a very short grower, hardy, and very prolific; not to be sown, however, till March.

*Woodford marrow*, full of flavour, of slow growth, admits of two or three sowings from March to mid-June.

25. *For early crops*, sow a few drills of the early sorts in a warm sheltered border in November and December; these may come in by May and June, but it is very uncertain.

“To forward an early crop, some gardeners pinch off the leading shoot when the peas are in blossom,—a device which accelerates the setting and maturity of the fruit.” Another mode is to sow in lines from east to west, and to stick a row of spruce fir branches along the north side of every row, sloping, so as to bend over the plants at about a foot from the ground. “As the plants advance in height, vary the position of the branches so as always to protect the peas from perpendicular cold or rain, and yet to leave them open to the full influence of the winter and spring sun.”

“Mr. Knight sowed peas in the open air, and others in pots, on the first day of March. In the last week of the month, those in pots were transplanted into rows in the open ground. On the 29th of April, the transplanted peas were fifteen, and the others four inches high; and in June, the former ripened twelve days before the latter.” (Loudon, 3607.)

*An early crop of peas is of great consequence; but the difficulty is*

to obtain it with safety. The following method is, doubtless, known to many practical gardeners, but not, perhaps, to persons in private life. It appears to be unexceptionable where materials and proper machinery are at hand. The season will be from Christmas to March. Procure strips of turf from a common, or meadow, of short grass; cut them to any required length to suit that of a wall, or fence, facing to the south. Each turf may be a yard or four feet long, four or five inches broad, and two or three inches thick. Reverse the turfs, and cut out, with a sharp knife, an angular strip of the soil along the middle of the earthy side. The groove thus formed, ought to be an inch and a-half deep. Scatter *early* peas in the groove pretty closely, so that the seeds may nearly touch each other; then cover them with rich, fine earth, or with the soil cut out, after having mixed it with one-third of reduced stable manure, and passed the compost through a wire sieve. Fill the groove entirely, and pat down the earth till it become pretty firm; then place these turfs on a vinery floor, or in a hot-bed frame, the latter to be covered with lights, and also mats, if frost be severe. These preparations being completed, it will be evident that, according to the heat applied, the process will be more or less rapid; but, at all events, protection from vermin and bad weather will be secured. Moisture being duly afforded, the peas will vegetate; and when they have attained the growth of two or three inches, they, with the turfs, are to be transferred to the open air, and placed in a drill two feet in front of a south wall or fence. Two circumstances should be attended to, to render the operation complete. The first is, that if the peas have been excited in a vinery *at work*, the turfs ought to be placed in a vacant frame, or green-house, for three or four days, to become inured by degrees to a change of situation. The second, that, in order to guard against future drought, a trench should be opened under the fence, six inches deep and wide, and be half filled with fresh maiden earth. The earth thus prepared should then be saturated with water, left a day to settle, and covered with half the soil that had been dugged out of the trench, or so much of it as to allow the peas, when the turfs are laid in the soil, to be earthed up to the height of half an inch; a gentle watering may then be given to settle the soil and refresh the plants. When these have grown an inch, a little more earth should be drawn to them, and when they rise three inches above the last earth, short branchy sticks should be stuck in the ground, close to the plants, along the whole line, on the south side of them. The sun will attract the peas, and the sticks will protect, as well as support them. Taller pea-sticks will ultimately be required; but this variety rarely grows above a yard high.

26. *For succession crops*, sow in January, and thence every three or four weeks, till the end of May; or with a view to have a constant succession of peas, a good general rule during the spring will be to sow another crop, as soon as the one last sown shall be fairly above ground. Just as the peas emerge, and show their tips, cover them with evergreen boughs, to protect them from the sparrows. These birds attack the peas about the time they rise from the ground, eat off the pea, and leave the young shoot, as if to mock the sower. The boughs may be safely removed when the shoots have attained an inch or two in height. As to winter-sown peas, it is not improbable that those sown in November will be as backward, nearly, as those that are sown in February. For the earlier sowing, the drills should be an inch and a-half deep, and four or five feet asunder. The frame and Charltons may be sown two or three in an inch: the Prussian blue, three in two inches; and the large marrowfats a full inch apart. A pint of the small sorts may sow a row of twenty yards; and the same measure of the large sorts is sufficient for thirty-three yards.

27. *For late crops*, the frame, Charlton, or Warwick, may again be sown from mid-June to the first week in August; but the best sort is said to be Knight's marrowfats, which may be set at intervals of ten days, where there is plenty of spare ground, from the beginning to the end of June. "The ground is dugged over in the usual way, and the spaces to be occupied by the rows of peas are well soaked with water. The mould upon each side is then collected, so as to form ridges seven or eight inches above the previous level of the ground; and these ridges are well watered. The seeds are now sown in single rows, along the tops of the ridges: the plants grow vigorously, owing to the depth of soil, and abundant moisture. If dry weather at any time set in, water is supplied profusely once a week. In this way the plants continue green and vigorous, resisting mildew, and yielding fruit till subdued by frost." (Loudon, 3608.)

*Peas*, as well as beans, should not be set in plots of ground, row behind row: the peas are injured, if there be more than two rows, because they draw each other into long, straggling haulm; and where the extent and situation of the garden will admit of the practice, advantage will be gained by always sowing in long single rows. Suppose, for example, that six rows, four feet asunder, be set in a plot of ground; it is evident that not less than twenty-six feet must be occupied, allowing for three feet on each side of the two exterior rows, between the peas and any other sort of crop that is standing, or to be planted. Thus, ground will be lost; for when one, or at the utmost, two rows only are planted, cabbages, and any other short

vegetable, may be grown to advantage, at a very small distance from the peas; and even between the two rows, if required; whereas, this could not be done without great risk of their being much drawn up, if planted between the six rows; particularly in wet summers. This I was convinced of in 1828, when several rows of cabbages and savoys were much injured, by being set out between rows of peas in plots. *The Gardener's Magazine* has also given satisfactory proof of the propriety of departing from the old method of planting peas in successive rows.

28. *Subsequent culture of peas.* When they have advanced in growth to the height of two or three inches, draw earth to the stems of the plants, and keep the ground entirely free from weeds. In frosty weather, protect the rows by fern-leaves, long litter, or branches of evergreens; but remove all coverings whenever the return of mild and open weather shall have effectually thawed the ground, *but not before*. In dry parching seasons, some recommend watering. If this be undertaken, it must be done effectually, as in the case of Knight's pea (No. 27), otherwise an occasional sprinkling does harm. The peas should be stuck when about eight inches high. Nothing so effectually secures peas from drought as prepared trenches, in which is worked some half reduced leaves,—they contain the elements of water, and yield them to the roots. I proved the result in 1835, when peas were burnt up generally. One thorough watering of the trenches will be very effectual. The Charltons and dwarf imperials will require branchy sticks, of about four feet; those for the taller growers should be six or seven feet; and for Knight's, full ten feet high. On the sunny side of each row, *i. e.* east or south, place the sticks sufficiently close to keep the peas compact in the row, without falling through. Half the number will suffice for the north and west sides, as they are not so much exposed to the sun's attractive influence.

29. The *soil* best suited to peas is one that is moderately rich, and not manured with recent hot dung. A compost of light sandy loam, and vegetable mould, is good manure. "The soil for the early crops should be very dry, and rendered so, where the earth is moist, by mixing sand with it in the drills. For early crops, put in from October to the end of January; let the situation be sheltered, and the aspect sunny. For the middle crops after January, let it be open; and for the late, or autumn crops, return to a sunny border." Peas, however, delight in an open exposure: hence, the benefit of field culture.

Subject 3. THE KIDNEY-BEAN. *Leguminosæ. Phaseolus Vulgaris.*  
Class xvii. and Order iv. *Diadelphia Decandria*, of Linnæus.

30. The dwarf kidney-bean is the *Haricot* of the French. It is a half-hardy annual, native of India; and introduced, says Loudon, in 1597, or earlier. The species termed the runner (*Phaseolus multiflorus* of Willdenow), is a tender annual, and a native of South America, introduced in 1633. It flowers from July to September or October. The stems of both species are more or less twining—that of the dwarf but little so. The leaves are ternate, on long footstalks; the flowers papilionaceous, in racemes, produced from the axils of the leaves: those of the dwarfs are usually white, lilac, or pale purple; and of the runners, bright scarlet or white. The *carina*, or keel of the flower, is singularly contort or twisted, forming one of the essential generic characters of the plant. The pods are oblong, swelling slightly over the seeds, which are kidney-shaped, smooth, shining, and in colour white, black, buff, red, or spotted, according to the variety. The pods may be had in perfection from June to October; those of the runners, in very favourable seasons, till November. Speechly, in his *Practical Hints on Domestic Economy*, p. 15, suggests that the kidney-bean might become an object of national culture in the country, and be particularly useful in times of scarcity; more especially, as in good lands it will flower and grow luxuriantly, even in a dry, parching season; in which respect it differs from most other culinary vegetables. “It is an article of field culture in most warm countries; especially in France and America.”—Loudon, 3629.

31. *Varieties of the dwarfs.* The early yellow, black, and red spotted, are among the most hardy; the early white is later. Growers for sale are said to depend on the Canterbury and Battersea, for the main crops. All kidney-beans are liable to decay from moist and cold ground; therefore it is perfectly useless to sow the seed till the season become genial, and the ground warm by the sun's influence. No time of any consequence can be gained by sowing before the end of April, or the first week in May.

*Varieties of the runners.* The scarlet and the large white are the best bearers. The *painted lady*, with variegated red and white flowers, is a beautiful and prolific variety: being tender, and more liable to rot in wet ground than the dwarf, the runners should not be sown till about the middle of May; and thence, to the beginning of July. Mr. Cobbett, in his *American Gardener*, No. 197, observes very justly, that for *main crops* of kidney beans, “it is by no means advisable to sow very early. If you do, the seed lies long

in the ground, which is always injurious to the plant. The plants come up feebly; the cold weather makes them look yellow, and they then never produce a fine crop."

Runners are not strictly annual; like the dahlia, the processes of the roots are fleshy, and the collar is furnished with eyes. If these be covered in the soil, so as effectually to protect them from frost, a row of plants may be produced in the spring; a layer of leafy, linings' manure, nine inches thick, is an excellent guard, and will finely enrich the earth.

32. *Culture of both species.* The dwarf kidney-beans should be sown in a warm border for the early crops, in drills two and a-half or three feet asunder, and two inches deep. Drop the beans at regular distances, of about four inches—some say three inches; and rake the earth neatly over each drill, to the full depth of two inches. Sow, for *succession crops* of the different sorts, about once in three weeks, to the close of July, or even a month later; and in very dry weather, immerse the beans in water for seven or eight hours prior to sowing. Keep the earth occasionally well stirred with the hoe, and draw a little to the stems, as the plants attain five or six inches in height. Gather the pods in rather a young and tender state. The *runners* for the principal crops should be sown in drills, in an open bed, two inches deep, five feet apart at least, and four inches asunder in the rows. The beans may be planted also against walls, fences, and buildings, or along the sides of walks. They require tall sticks or cords, or trellis, to run on or over. A shady walk may be made by forming an arch with laths, or light materials, planting the beans on each side of the supporters. Some persons are very skilful at this sort of fancy work; and the effect produced by the transparent green of the leaves, and the rich scarlet of the blossoms, is particularly beautiful, when illumined and brought out by the sunbeams. *Scarlet-runners* will produce till stopped by frost; but it should be made an invariable rule to gather *every pod* as it attains a proper age, and by no means to leave one on the stalks to approach to maturity. If all be pulled off, the blossoms and beans will be produced in regular and continued succession; but if any of the pods remain ungathered, and verge towards ripeness, an important physical change (discoverable by the microscope) is effected in the cellular structure, and the vital energy of the plant appears to be directed solely to the process of maturing the seed.

"It deserves notice," says Abercrombie, "that in their voluble or twining habit of growth, the tendrils turn in a direction contrary to the apparent course of the sun. This aberration from the common habits of plants has been accounted for, by supposing that the

native climate of the scarlet-runner will be found to be south of the equator," (where the sun would be seen to the north at noon-day,) "and that the plant, although removed to a northern hemisphere, is still obedient to the course assigned to it by nature, turning in a direction which, in its native climate, would correspond with that of the sun."

Kidney-beans of both species will bear forcing in frames, previously to transplanting; and they bear transplanting remarkably well; and as they are very liable to damp off, and to be destroyed by slugs, it will be desirable to form a seed bed for each species, in some dry and protected spot. Let some hundreds of the beans be set, about four inches apart every way, and at about the same time as those in the drills; there will then be plants ready to fill up blank spaces in the rows, where such occur, or to form new plantations from the seed beds, according to the directions above given.

33. *The soil* for kidney-beans should be light and mellow, inclining to sandy rather than to stiff loam, for the early sowings; but for the summer crops, the soil may be much moister. It should be well digged, and properly manured, with moderately rich compost. The *quantity of seed* may be estimated at half a pint for 80 feet, to allow for planting at the distance of two and a-half or three inches.

34. *Saving the seed.* Select the earliest and finest pods, when ripe and mature, and lay them in the sun to dry; then clear them from the husks, and preserve them in bags or drawers, in a situation that is perfectly dry, but not exposed to the influence of artificial heat from fire. By the same means, the seed of all the leguminous tribe may be preserved.

#### FORCING THE KIDNEY-BEAN.

The dwarf varieties force extremely well in pots, and become a delicious treat to those who possess the convenience of a vegetable, plant, or strawberry-house. Sow five or six seeds of the yellow, or buff beans, in a 48-size pot, having previously inserted a loose, fibrous turf, at the bottom of each pot, to act as drainage, and filled it with light, rich loam. Place the beans near to the sides, one inch under the soil; and set the pots in a forcing-house, where the fire heat is never below sixty degrees. When the plants have filled their pots with roots, remove them, with entire balls, of which the turfs form the bases, into "twenty-fours," prepared as the "forty-eights." Place them rather deeply, so that as the beans grow, earth may be gradually applied higher on the stems; finally, leave an inch space to admit of a due supply of water. If the plants run high, they must be stopped at an upper

joint, and be supported by sticks and ties; but this is an evil to be guarded against by air, and a free exposure to sun, setting the pots at no great distance below the glass.

Water, regularly supplied, so that the soil be never droughted, is essential; and a moist atmosphere is the only safeguard against that pest, the *red-spider*, (*acarus tellureus* or *holosericeus*.)

*Kidney-beans* may be forced from September to March and April, and thus, a supply will be obtained till the crops in the open ground come into bearing. They will bear the heat (by sun) of a pine-stove; i. e., 75 to 80 degrees.

## PART II.

### IMPLEMENTS OR TOOLS EMPLOYED IN GARDENING.

35. The instruments that have been invented for the performance of the operations of gardening, are very numerous. Of these, not fewer than seventy-six are figured and described in LONDON'S *Encyclopædia*. Some of them are indispensably required by every gardener; and those that I have considered to be such, in gardens possessed of any common degree of capability, I have noticed in the annexed list, which precedes the calendarial directions for the operations in the kitchen garden, for January.

1. *The spade*, for digging, trenching, and planting.

2. *The shovel*, for gathering up and removing manure, litter, &c.

3. *The fork*. Of this tool there are three principal descriptions:—

1. The pitchfork of two prongs, for working dung and litter—
2. The three prong, with flat points, for digging among shrubs, forking asparagus, &c.—
3. The hand fork, for light work in flower borders.

4. *The hand-trowel*, with a curved blade, for planting and removing bulbs and herbaceous plants.

5. *The dibber*, of two sorts:—1. Sharp pointed, sometimes shod with iron, and made of, or like, the handle of a spade.—2. The same in shape, but blunt-pointed, for making holes of equal diameter throughout.

6. *The pick-axe*, or planter's mattock, for grubbing up roots, or working in refractory ground.

7. *The hoe*, of two sorts, and of various sizes and breadths.—1. The drag, or draw-hoe, for drawing drills, weeding, and earthing up: the blades may be from three or four to six or seven inches across.—2. The Dutch or thrust hoe: a most convenient tool for light weeding, and for loosening the surface of the ground. The operator thrusts

it forward, and as the work proceeds, walks backward, and thus avoids treading on the hoed ground.

8. *The rake*, for dressing beds and borders. Three sizes are required, varying in breadth from six to eighteen inches; and also in the length, strength, and distance of the teeth. A *wooden hay-rake* is useful for removing litter, mown grass, leaves, &c. All rakes are improved when the teeth are fixed in wooden heads.

9. *The pruning-knife*.—One with a blade more or less curved, for trimming trees; another, with a straight blade, and very sharp point, for cutting off the smaller twigs; the “*Wharnccliffe*” pruning-knife, originally made by Rodgers, of Sheffield, is a truly convenient implement.

10. *The grafting and budding-knife*, with a thinner straight blade, curved off, and sharpened at the back, towards the point.

11. *The garden shears*, for clipping quickset hedges.

12. *The garden hook*, for trimming hedges, cutting nettles, &c.

The foregoing list contains the tools which are of general utility: there are others, such as the pruning and grafting chisel, pruning-saw, edging shears, scythe, garden lines with iron swivel, &c. which are often required. For most gardens, two, at least, of Nos. 1, 3, 4, and 5, should be kept; and if the extent be considerable, and there be more than one person employed in the garden, each pair of hands ought to have one of these tools, and (as far as concerns the spade, No. 1,) of the weight and dimensions best suited to the strength of the operator.

### PART III.

#### OPERATIONS IN THE VEGETABLE GARDEN, FOR THE MONTH OF JANUARY.

36. If the month prove frosty, the only directions to be given are, to wheel dung or manure compost to the plots or quarters which stand in need of improvement; to protect, by temporary coverings of fern-leaves, (*i. e.* fronds of fern,) long litter, or Russia mats, stretched over hoops, &c., vegetables that might suffer from severe frosts and cutting winds: such are—celery, young peas, beans, lettuces, small cabbage-plants, cauliflowers, endive, and the like. Remove these coverings in settled mild intervals, when the ground is *thoroughly thawed*; for otherwise, to expose plants whose vessels are penetrated by frost, to the sudden action of a powerful sun, would be about as wise as to expose a frozen limb to the action of a kitchen fire, or to plunge it into warm water; and probably would be productive of a corresponding beneficial result! Take advantage

of such intervals, when the surface of the ground is pretty dry, to draw a little fine earth against the stems of peas, beans, brocoli, &c. Attend to neatness; removing dead leaves into a pit, or separate space, to form *leaf mould*, and litter of every kind from the garden, to the compost heap. Destroy slugs, and the eggs of insects. Dig and trench vacant spaces, when the ground is free and dry; but if it be sodden with water, to disturb it will do more harm than good. Operations of this description should always be performed when the earth will work and pulverize freely, and without clodding.

If the weather be mild and open, and the state of the ground favourable.

*Sow.*—Peas; early Warwick, frame and Charlton, about the first or second week;—the Prussian and dwarf Imperial, about the last week.

Beans; early mazagan and long pods, about the first and last week.

Lettuce; in a warm sheltered spot:—choose the hardy sorts, as the Cos and brown Dutch; but not before the last week.

Radishes; in the second and fourth week, the short top, and early dwarf.

*Transplant.*—Cabbages; the early York and sugar-loaf, about the close of the month.

*Earth up* the stems of brocoli and savoys; also rows of celery, to blanch and preserve the plants.

*General observation.* It is a good plan to mark every row that is sown, or planted at any time, with a *cutting* of a gooseberry, currant, China rose, or of some plant that will strike root readily: by this means, a useful or ornamental fruit or flowering shrub, is often gained, which may be transplanted at almost any time—and the ground is marked: thus two objects are attained.

### SECTION III.

#### PART I.

#### NATURAL HISTORY AND CULTIVATION OF THE POMIFEROUS TRIBE, OR KERNEL FRUIT-TREES.

Subject 1. THE APPLE-TREE:—*Pyrus Malus*. *Rosaceæ*. Class xii., and Order ii., *Icosandria Di-Pentagynæa*, of Linnæus.

THE essential generic character of the genus *Pyrus*, is “a calyx superior, five cleft; petals five. Apple, with from two to five mem-

branaceous capsules; seeds two." (Smith's *English Flora*.) The styles are from two to five in number.

37. *The Apple* produces its blossoms in terminating umbels, on short spurs proceeding from the sides and ends of the branches of the wood of two, three, or more years' growth. The fruit is roundish, containing a pulp of firm texture, and sub-acid taste; the seeds or pips are ovate, flattened or compressed, and are produced in five or six oval, coriaceous cells, in the centre of the fruit. "In its wild state it is termed *the Crab*, and is then armed with thorns." According to Loudon, No. 4369, it appears, that, in all probability, the apple was introduced by the Romans, to whom twenty-two varieties were known in Pliny's time; and these greatly increased at the Norman conquest. Loudon in his Catalogue, at No. 4377, gives the names of two hundred and forty-one varieties.

This tree is supposed by some to attain a great age; but Mr. Knight considered two hundred years as the ordinary duration of a healthy tree. Speechly mentions a tree near Nottingham, "of about sixty years old, with branches extending from seven to nine yards round the bole, which in 1792, produced upwards of one hundred pecks of apples." The apple-tree accommodates itself to almost any soil or situation of the British Isles. "Good apples are grown in the Highlands and Orkneys, as well as in Devonshire and Cornwall; some sorts are ripe in the beginning of July, and others, which ripen later, will keep till June."

38. *Propagation*. The apple may be propagated by seeds, by cuttings, suckers, layers, or by engrafting. The first method is practised with a view to multiply varieties, or to raise stocks for subsequent graftings. Mr. Knight, the late President of the Horticultural Society, performed many ingenious experiments on seedling plants; among others, he cut out the stamens of the blossoms to be impregnated, and afterwards, when the stigma, or female organ of the same seedling was matured, he introduced the farina or pollen, produced by the stamina of another parent. "In this way he produced the Downton, red and yellow Ingestrie, and grange pippin, from the same parents; viz., the seed of the orange pippin, and the farina of the golden pippin." The Downton Nonpareil is another apple raised subsequently, by Mr. Knight. The seeds may be sown in autumn, in light earth, covered an inch, either in pots or beds. The end of the first year they should be transplanted into nursery rows, from six to twelve inches apart every way. Afterwards they should be planted out where they are to remain; the distance between each being, according to Mr. Williams, six or eight feet.

The second method, by *cuttings*, may readily be practised, as all the varieties may succeed thereby, though some much more readily than others. Those of the Bur-knot or codling tribe, grow as well this way as by any other; in fact, boughs of an inch or two in thickness, if furnished with roundish knobs or burrs, with fibrous processes all around them, (which may frequently be observed,) if planted pretty deep, in October and November, will, as I have proved, produce fine apples in the following year. "The trees raised by cuttings are not liable to canker," (see *Hort. Trans.* vol. i. 120,) "and this is supposed to be owing to their putting out no tap-root, but spreading their numerous fibres from the burrs horizontally." "All apple-trees raised this way," Biggs observes, "from healthy, one-year old branches, with blossoms on them, will continue to go on bearing the finest fruit, in a small compass, for several years. The cuttings should generally be young wood, with a small portion of old wood at the lower end. Cut off the tips of the shoots, and all the buds, except two or three nearest to the upper extremity; then, smooth the cuttings at the lower end, and plant them three or four inches deep, in sandy loam, pressing the earth firmly to them, watering, and covering them with a hand-glass." Let this be done in February; and do not remove the glass, except to give water, till the plants have made an inch or two of shoot. Shade them from the mid-day sun, and give air in July: and in October, the plants may be removed into pots, or nursery rows.

By *layers* the success is considered to be certain, and the desired variety is of course obtained. The process of layering will be described in a future number.

*Grafting* is the chief method of propagating the apple, and the one almost universally adopted in the nurseries. The various modes of performing this operation will be described in a future section: at present it will be sufficient to notice the treatment of the scions or grafts, and the season when they should be collected. Knight observes, "the branches which are to form the graft, should be taken from the parent stock during the winter, and not later than the end of the preceding year; for if the buds have begun to vegetate in the slightest degree, (and they do begin with the increasing influence of the sun,) the vigour of the shoots during the first season will be diminished, and the grafts will not succeed with equal certainty. The amputated branches (or scions) must be kept alive till wanted, by having the end of each planted in the ground a few inches deep, in a shady situation."

Whatever may result from dry and thirsty scions, certain it is, that cuttings of the wood of the preceding spring, taken off after the

buds are swollen, and placed immediately on young and vigorous stocks, will succeed, and grow directly; thus, late in April, I have successfully grafted in the rind, the Blenheim and Downton pippin, and the French crab, or Easter apple.

*Stocks for full standards*, may be grafted at about six feet from the ground; or they may be grafted near the ground, and a single shoot trained from the graft, to form the stem. For middle-sized trees, or *half-standards*, three or four feet from the ground is reckoned a proper height; and for *dwarfs*, eight or ten inches, or even lower. Miller and Knight agree in recommending to “graft near the ground, where lasting and vigorous trees are wanted.” For moderate sized stocks, *whip* or *tongue-grafting* is the method usually adopted; “or the new mode of *saddle-grafting* adopted by Knight; and the general term is the end of February, and the greater part of March. Much depends on the season and situation. The guiding principle is to make choice of the time when the sap of the stock is in full motion, while that of the scions is less so, from having been cut off and placed in the shade.”

Old and ill-bearing trees are successfully renewed, by the process called *crown-grafting*. This may be performed during March; and besides the success which often attends it, a variety of sorts may be introduced into one and the same stock. Crown-grafting has been practised by me during more than seven years in my own garden, with very gratifying success, upon stocks of all sizes and ages: the wounds heal speedily and cicatrize completely: it is no uncommon circumstance to see two or more varieties upon dwarf or espalier trees, the junction of which it is difficult to ascertain.

39. *Apple-trees are trained* as full standards, half-standards, and dwarfs. The first of these is suitable to orchards; the two latter to small departments: the dwarfs, particularly, are fine bearers, and are easily kept in good order.

*Espaliers*, according to Mearns, require, in the first stage of training, the stakes to stand as close as twelve or fourteen inches; and at the height of fully five feet, to be furnished with a cross rail, to connect the tops, as well as to steady them. As the trees extend their horizontal branches, and acquire substance, the two stakes on each side of the one that supports the centre leader of the tree, may be removed to either of the extremities where wanted; and as the tree extends further, and acquires more strength, every other stake will be found sufficient.

*Espaliers* are formed by selecting young trees with three fine shoots. Train in the two lower, at about eight or nine inches from the ground, along small horizontal sticks or laths, nailed or tied to

the upright stakes : these will guide the shoots correctly. In the pruning season, cut down the middle shoot to about the length of twelve inches from the base of the two lower shoots ; train in the well placed shoots that advance from the middle shoot ; tie them along similar horizontal sticks, with soft, wet Russia mat, or bass, and secure the perpendicular direction of the upright leader. The horizontal branches should be trained to regular distances of about six inches apart. Espaliers require a *summer* and a *winter pruning*. In the former, lay in the young shoots of the year which are likely to be wanted, and remove all the foreright and misplaced shoots, keeping those that are healthy and well placed, in regular order, so as to preserve the utmost neatness of appearance\*. For the method of the winter pruning, see No. 45.

40. *Modes of bearing, and manner of pruning.* “As the apple bears upon short spurs or shoots, which spring from the younger branches of two or more years growth, appearing first at the extremities, and extending gradually down the sides ; the same branches and fruit spurs continue many years fruitful ; therefore, from this mode of bearing, apple-trees do not admit of shortening in the general bearers : it should only be practised occasionally, first, where any extend out of limits, or grow irregular and deformed ; and secondly, a good shoot contiguous to a vacant space, is shortened to a few eyes, to obtain an additional supply of young wood from the lower buds of the shoot, for filling up the vacancy. But to shorten without such a motive, is not merely to cut away the first and principal bearing part of the branches, but it also occasions their putting forth many strong, useless wood shoots, where fruit spurs would otherwise arise ; whereas, the fertile branches being cultivated to their natural length, shoot moderately, and have fruit spurs to the extremity.” (ABERCROMBIE.)

41. *Soil and situation.*—Knight observes, that the apple-tree attains its largest stature in a deep strong loam or marly clay. “The most suitable land to plant the apple-tree in,” according to M’Phael, (*Gardener’s Remr.* p. 137,) “is a brownish mellow loam, not less than three feet in depth, on a dry bottom. It will, however, do, when planted in other kinds of earth, such as sandy, gravelly, or clayey soils of various depths. Before the trees are planted, the ground for them should, if it will admit, be trenched two feet deep, and more or less manure mixed with it, in proportion according to

\* Compare the above directions with those of Harrison, detailed at some length in the article *plum-trees*, June, Section III., which are in a great degree applicable to the *apple* and *pear-trees*.

the richness or poverty of the state it is found in. If the soil be of a clayey or brick-earth nature, mix it well with vegetable mould, rotten dung, or any other kind of manure of an opening quality; such as peat ashes, soot, or the scrapings of streets. If the earth be light, or of a sandy nature, besides manure, mix it with some strong soil of a marly nature."—(See chiefly Loudon's *Encyclopædia*, article *Apple*.)

It is proper to add that, later experience has confirmed the important fact of the great mischief which results from deep planting, deep soil, and the application of manure or dung. Pure maiden loam, or turfy loam from a common, placed eighteen inches deep, upon a well-rammed stratum of rocky fragments, gravel stones, brickbats, and lumps of chalk, forms the most appropriate bed for fruit-trees. If manure be used, it should be laid on the soil, above, and over the roots, as *mulch*, but never in contact with them: this accords with the principles of the celebrated Evelyn, and the late respected Mr. Knight.

42. *Choice of Sorts.* In making a selection of apple trees, the extent of the ground, its capabilities, and the taste of the occupier, must all be taken into consideration. Nicol, a noted Scotch author, recommends the following varieties; I add the two Nonpareils.

" Ribston Pippin,	Carlisle Codling,	Kentish Rennet,
Oslin do.	Royal Russet,	Margaret Apple,
Gogar do.	Norfolk Beaufin,	Grey Leadington,
Kentish do.	Royal Pearmain,	Yorkshire Greening,
White Hawthorndean,	Loan's do.	Margill,
Royal Codling,	Golden Rennet,	Pursemouth,"
Kentish do.	Old Nonpareil,	Downton Nonpareil.

#### Subject 2. PEAR:—*Pyrus communis*.

43. The *Pear-Tree* is another species of the same genus as the apple, and like that tree, is, in its wild state, thorny; but differs from it in its mode of growth, by tending to the pyramidal form. The blossoms are white, on terminating corymbs, (*tufts or clusters*), from buds produced on short spurs. It is, in its wild state, a native of England, France, and Germany. Loudon, at No. 4433, says, that in Pliny's time, the Romans possessed thirty-six varieties, and that the pear is still more valued in France and Italy than the apple. He adds, that Tusser, in 1573, in his list of fruits, mentions, "peeres of all sorts." Miller selected eighty sorts. In France, the varieties are more numerous than those of the apple. The British nursery lists at present contain from two to three

hundred names ; and he himself selects and describes one hundred and fifteen. (No. 4437.)

44. The *Pear* may be propagated by layers and suckers, but not readily by cuttings. The plan of raising from seed, for stocks, is preferred, with the view to obtain varieties by grafting and budding. "The most common stocks for grafting, are the common pear and wilding ; but as the apple is dwarfed and brought into more early bearing, by grafting on the paradise or creeper, so is the pear, by grafting on the quince or whitethorn. It will also succeed on the whitebeam or medlar, service or apple. Dubreul, a French gardener, recommends the quince-stock for clayey and light soils, and the free-stock (*i. e.* a stock raised from the seed of the pear), for chalky and siliceous soils." According to Abercrombie, pear-trees prefer a dry, deep loam, when the stock is of its own species : on the quince, it wants a moist soil. Knight and M'Phael recommend a strong, deep loam ; and the latter, a high wall for training the better sorts.

45. *Pruning and training Standards*.—Permit them to spread out freely on every side, keep the heads moderately open, and displace only and cut clean out, any cross or very irregular shoots. "Pruning," Knight observes, "is not often wanted in the culture of the pear-tree, which is rarely encumbered with superfluous branches ; but in kinds whose form of growth resembles the apple-tree, it will sometimes be beneficial." In pruning *espalier*, or *wall-trees*, the same rule will apply both to the pear and the apple-tree. Abercrombie recommends in the winter pruning, that their branches be not shortened, but trained horizontally to the wall or espalier to their full length, and at the distance of about five or six inches. If there be vacancies, train in a last summer's shoot ; or if these require two or three shoots, then it may be needful to shorten a main shoot to three or four buds, to induce it to throw out young wood the summer following. In the course of this pruning, take care to preserve all natural fruit-spurs ; but cut clean out all those formed of the stumps of shortened shoots, as they only tend to produce useless wood-shoots." Harrison and others adopt the mode of keeping only short spurs, each of which bear but once ; then it is cut out, and is succeeded by an embryo bud at the base. Harrison has some curious observations on the subject.

46. *Setting the fruit*. He observes, that it is common to see healthy-looking trees, which produce abundance of blossoms, and but little fruit : he considers the barrenness to arise from the *stamina* being destitute of *farina* ; or, that the *farina* has fallen before the *pistillum* had attained a proper state for its reception.

To remedy such defects, he impregnates six blossoms on each corymb, as soon as the pistillum is in a state of maturity; and chooses for this operation, blossoms which appear nearest to the origin of the spurs, these being the most likely to set. He chooses a dry, calm day, and when the sun is not very hot; and, after the operation, gives each tree eighteen gallons of manure water, or soft pond water, at the roots. See LONDON, *Ency. Gard.* No. 4457.

The great variety of pears precludes any specific directions for a choice; everything must depend upon taste and conveniences.

As standards for the orchard: the Windsor, an early bearer, Bergamots, the summer, autumn,—and the orange-jergonelle are choice favourites.

As dwarfs, or wall-trees, for the garden, the brown and green Beurrée; the Easter Beurrée is extremely fine, and is a fine keeper; Beurrée d'Aremberg, and Napoleon, both very prolific, ripe in November.

Pears in the garden, should, if possible, be trained as dwarf, or half standards. Mr. Knight has raised many new varieties, all of which bear profusely when so trained: in fact, many of the new French and Flemish pears will succeed perfectly as small open standards or dwarfs.

### Subject 3. THE QUINCE:—*Cydonia Vulgaris*, formerly *Pyrus Cydonia*.

47. The *Quince-tree* is of low growth, much branched, and generally crooked and distorted. The leaves are roundish or ovate, entire, dusky green, whitish underneath, on short petioles (foot-stalks). The flowers are large, white, or pale red, and appear in May and June; the fruit, a pome, varying in shape in the different varieties, globular, oblong, and ovate. It is a native of Austria and other parts of Europe; and is mentioned by Tusser, in 1573. (*Ency. Gard.* 4459.)

The *varieties*, according to Miller, are four in number, viz.

1. *The pear quince*, with oblong leaves and fruit.
2. *The apple quince*, with ovate leaves, and rounder fruit.
3. *The Portugal quince*—fruit oblong, more juicy and less harsh, cultivated for marmalade, as the pulp assumes a red or purplish tint when prepared.
4. *The mild, or eatable quince*, less austere than any others.

The quince-tree is propagated by layers, cuttings, and by *grafting*; it prefers a moist, soft soil; the soil in which it is

planted can scarcely, indeed be too moist,—not to say, wet. It is almost invariably trained as a standard tree.

Subject 4. MEDLAR:—*Mespilus germanica*. Class xii. Order ii.  
*Icosandria Pentagynia*.

48. *The medlar* is a small branching tree, with ash-coloured bark, oval, lanceolate, serrated leaves, on short footstalks. The flowers are produced on small spurs, at the ends and sides of the branches. Bractes (or floral leaves) as long as the corolla; calyces terminating, fleshy; petals white: fruit, a turbinate berry, crowned with the five permanent segments of the calyx; pulp thick, mixed with hard granules; and containing five gibbous, wrinkled stones. It is a native of the south of Europe, but appears to be naturalized in some parts of England. The sorts or varieties cultivated, are,

1. *The Dutch medlar*,—flowers and fruit large, the latter approaching to the shape of an apple.

2. *The Nottingham medlar*,—the fruit of a more poignant taste.

3. *The wild medlar*,—with smaller leaves, flowers and fruit.

*It is propagated* by seeds sown with the pulp, layers, cuttings, or by grafting on seedlings of its own species, or on the other species of *mespilus*. The tree prefers a loamy, rich earth, rather moist than dry.

In *pruning*, Forsyth directs the same sort of treatment for the medlar as for the quince—namely, to “cut out all the dead or cankered wood, and to keep the trees thin of branches, where it is desired to have large fruit.” (*Ency. Gard.*—Medlar, No. 4465.)

*Gather the fruit* in October or November, when full grown; lay it on shelves, or on a dry floor, so that the medlars do not touch each other. When matured, they will be soft, the pulp brown, and resembling that of a decayed apple. *Light* appears to be influential in hastening this maturing process; hence it may be considered one of electro-chemical agency.

## PART II.

### OPERATIONS IN THE FRUIT DEPARTMENT.

49. *Prune*—Apple, pear, peach, nectarine, and apricot trees; examine the espaliers, and wall fruit-trees, and remove all decayed shreds or tyers. In pruning gooseberry and currant-bushes, clear them of all superfluous shoots, and of those which cross each other.

*Plant*, in open weather, fruit-trees of almost every kind.

*Dig* and stir the earth after the trees have been pruned and nailed. Destroy vermin either by pouring boiling water about the

stems and roots of trees, or by washing the stems and main branches with a liquor composed of about four pounds of quick lime, and four ounces of flowers of sulphur, first carefully mixing them with a little water, and then adding more till it becomes of the consistence of cream;—lay it on with a stiff painter's brush. If the sediment be suffered to subside, the yellow supernatant fluid will be found an excellent wash, which may supersede almost every other application for the destruction of moss or lichens, as well as of insects. This preparation has recently been paraded in the newspapers as a new discovery. I myself employed it in the year 1801, for the pine-apple when attacked by the *coccus*, or turtle-insect; and I never subsequently saw it mentioned in print, till after the publication of this work: so much for pretended discoveries.

#### MISCELLANEOUS.

50. *Flowering Shrubs* may now be planted: they may also be pruned,—carefully removing irregular and cross branches. Remark, that shrubs which produce their flowers at the extremities of the branches, as the lilac, must not now be shortened; for by so doing, the blossoms of the ensuing spring would be cut off. Others that blow from buds formed on the stems, such as *laburnum*, may be pruned to any desirable height. When the shrubs are pruned, dig the departments all over, and make them neat and regular.

Box edgings may now be planted, if this work have not been performed in October, which month is to be preferred.

*Flower borders*, if they have not been hitherto dressed, should now be stirred up (in mild, open weather,) with the hand-fork. Work in some light compost manure, which is blended with some rotted cow-dung. Care should be taken to avoid injuring bulbous roots and herbaceous plants not yet appearing above ground; and during this operation of dressing the borders, other roots may be planted to fill up vacant spaces; but it is quite early enough for planting, and the better sort of roots should not be planted till February or March.

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### THE NATURALISTS' CALENDAR.

#### JANUARY.

“JANUARY is usually found to be the month in which the cold is most intense; there being little or no frost in this country before the shortest day, conformably to the old saying,—‘as the days begin to *lengthen*, the frost begins to strengthen.’”

"The weather is commonly either bright, dry frost, or fog and snow; with cold, dark showers, about the close of the month."—*AIKIN'S Calend. of the Year*. There are, however, decided exceptions to the rule; for, after a very wet autumn, the weather may settle at the turn of days, and become dry without frost; such was the case, to a remarkable extent, after the very wet autumn of 1821; for the early weeks of January furnished several beautiful days, with a temperature of from 40° to 45°. When such mild, open weather does occur, the succeeding month too often furnishes a sad reverse, evincing a tendency to make good another old saying, "If the grass do grow in Janevere, 'twill grow the worse for't all the yere."

It will become a fact of chronology that, the three last weeks of January, 1838, after a Christmas of peculiar splendour and high temperature (from 45° to nearly 60°), we were visited with frost of unusual severity, accompanied with extremely little snow. On the morning of the twentieth day, about sun-rise, the mercury of my instrument receded to 2 degrees below zero: in parts of Berkshire and Buckinghamshire 6 degrees minus were observed: and the snow did not once cover the young wheat, which lost plant in some places in consequence of the subsequent power of a scorching, brilliant sun. Situations not four miles apart experienced a difference of several degrees.

Average height of the Barometer, in inches and hundredth parts, 29 5

Average height of the Thermometer, in degrees . . . 34½

*About the first week*;—shell-less snails or slugs, (*Helix*) and earth worms (*Lumbricus terrestris*) appear.

*Second week*;—red-breast, (*Motacilla rubicola*) sings; nut-hatch, (*Sitta europæa*) heard; hedge-sparrow, (*Motacilla modularis*) gray, and white wagtail, (*Motacilla cœrulea et alba*) appear.

*Third week*;—larks, (*Alauda pratensis*) congregate; missel, or mistletoe-thrush, expressively styled, in some counties, "the storm-cock," (*Turdus viscivorus*) sings; green woodpecker, (*Picus viridis*) utters its laughing notes; blackbird, (*Turdus merula*) if the weather be fine and open, is frequently heard; wren, (*Motacilla troglodytes*) sings; its note is most vivid, rapid, and joyous.

*Fourth week*, and to the end of the month;—sky-lark, (*Alauda arvensis*); wood-lark, (*Alauda arborea*); chaffinch, (*Fringilla cœlebs*); and one or two species of titmouse, (*Parus*) sing.

## F E B R U A R Y.

## SECTION I.

## SCIENCE OF GARDENING.

## PART I.

## ELECTRICITY.

51. AFTER what has been said in the first section of January, on the agency of *earths and soils*, in the preparation of nourishment, and its distribution to the fibres and roots of plants, it would appear most natural to enter at once into an investigation of the nature and offices of *water*; the importance of which fluid to the life and growth of plants, is familiarly known to every one. In fact, it would probably suggest itself on reflection, even to superficial observers, that as plants could not be supported without a medium in which to establish their roots, neither could they grow or thrive, without a due supply of sap; a fluid that is chiefly derived from water, the proximate element of the nutritive matters contained in the soil. Although it is acknowledged that water stands next in order to the earths, as an operative agent in the process of vegetable growth; still, however, consistency requires that the investigation of *causes*, or first principles, should precede the recital of effects. To excite the inquiring mind to such investigation, has been my avowed object; and as I am fully persuaded that electricity,—I mean electricity in the most comprehensive meaning of the term,—is the actuating cause of all the phenomena, not only of vegetable life, but also of those attendant on the formation and decomposition of water itself, I could not, consistently with this persuasion, enter upon the consideration of any other of the natural agents, (most of which appear to me to be effects, produced by the operation of some mighty cause) until I had endeavoured to trace that cause to its source, with a view to discover its nature and operations; and especially, since with this investigation is connected the inquiry into the existence of the “*one general principle*,” which was alluded to by Professor Playfair in one of his last lectures, an extract from which is given in the preface.

52. *The electricity of nature*, though probably the most influential of her agents, has been but little known, and still less

understood. It should be observed that I do not intend to confine myself to an inquiry into the phenomena of electricity, in the usual acceptation of the term; nor do I mean to make this section a treatise on that science: they who desire to become acquainted with common or artificial electricity, will find ample means of instruction in the treatises of Priestley, Franklin, and Eeles: they may also derive much information from the perusal of the many lectures delivered at the London Mechanics' Institution, as they are reported in the *Mechanics' Register*; and also from a *Treatise on Electricity*, published in two parts, under the superintendence of the Society for the Diffusion of Useful Knowledge. That impartial little work (a work which, when I have occasion to quote, I shall, for the sake of conciseness, simply style *the Treatise*,) commences by stating, that "The science of electricity, which now ranks as one of the most important branches of natural philosophy, is wholly one of modern creation. The observations of Boyle, Otto Guericke, Newton, and a few other philosophers of the same period, contributed somewhat to the extension of our knowledge on this curious subject; but the information collected during the whole of that period amounted to nothing that could be entitled to the name of science."

This is doubtless true to a great extent; though it must be admitted, that the ancients possessed some sublime ideas on the subject of elementary fire, which they considered as the grand agent in animal life and vegetable growth. There cannot, however, be a doubt, that during the nineteenth century, the experiments of Davy and other philosophical chemists on that important modification of electricity termed *galvanism*, (or, as it might with much greater propriety be styled, *chemical electricity*,) by demonstrating the intimate connexion which exists between electricity, chemistry, and magnetism, have done more towards the extension of the light and dominion of science, than was effected by the labours and treatises of any, or of all who laid claim to the title of philosopher, since the discovery of the art of printing. "So rapid," says *the Treatise*, "has been the march of science and improvement, that it is difficult for those whose attention has not been steadily and exclusively devoted to these particular objects, to keep pace with the progress of discovery."

53. *Agency of Electricity in Vegetation*.—Notwithstanding the surprising advance of the science of electro-chemistry, it is certain that there has been no corresponding advance towards a clear insight into the nature and extent of the energy which electricity exerts in the developement and growth of vegetable organized beings. In fact, till very lately, the subject appears to have excited scarcely any

attention, as will be rendered evident from the quotations which I am about to give from the scanty and meagre authorities which I have been able to collect from various authors. At numbers 1196, 1210, 1211, and 1212 of LONDON'S *Encyclopædia* (edit. 1826), we read as follows:—

“*The heat of the sun is the source of growth, and its light the cause of maturity in the vegetable kingdom; this is universally acknowledged: animals will live without, or with very little light; but no plants whatever can exist for any time without the presence of this element. The agency of electricity in vegetation is less known.*”

“*Electrical changes are constantly taking place in nature on the surface of the earth, and in the atmosphere; but as yet the effects of this power in vegetation have not been correctly estimated. It has been shown by experiments, made by means of the voltaic battery, that compound bodies in general are capable of being decomposed by electric powers, and it is probable, that the various electrical phenomena occurring in our system, must influence both the germination of seeds and the growth of plants. It has been found, that corn sprouted much more rapidly in water positively electrified by the voltaic instrument, than in water negatively electrified; and experiments made upon the atmosphere, show that clouds are usually negative; and as when a cloud is in one state of electricity, the surface of the earth is brought into an opposite state, it is probable that, in common cases, the surface of the earth is positive. A similar experiment is related by Dr. Darwin.*” (*Phytologia*, sect. 13. 2, 3.)

“*Respecting the nature of electricity, different opinions are entertained amongst scientific men; by some, the phenomena are conceived to depend upon a single subtile fluid, in excess, in the bodies said to be positively electrified, and in deficiency, in the bodies said to be negatively electrified. A second class supposes the effects to be produced by two different fluids, called by them the vitreous fluid, and the resinous fluid; and others regard them as affections or motions of matter; or an exhibition of attractive powers, similar to those which produce chemical combination and decomposition, but usually exerting them in masses.*”—DAVY'S *Second Agricultural Lecture*.

“*A profitable application of electricity, Dr. Darwin observes, to promote the growth of plants, is not yet discovered; it is nevertheless probable that, in dry seasons, the erection of numerous metallic points on the surface of the ground, but a few feet high, might, in the night time, contribute to precipitate the dew, by faci-*

litating the passage of electricity from the air into the earth; and that an erection of such points higher in the air, by means of wires wrapped round tall rods, or elevated on buildings, might precipitate showers from the higher parts of the atmosphere. Such points erected in gardens might promote a quicker vegetation of the plants in their vicinity, by supplying them more abundantly with the electric ether.”—*Phytologia*, 13, 4.

54. *Theories on Vegetable Electricity*.—It is evident from the foregoing quotations, that the influence of the electric fluid upon vegetation, was, at a very recent period, but imperfectly understood. Dr. Darwin had doubtless felt a gleam of the truth; but he appears to have overlooked the presence of the pointed terminations of grass, herbage, leaves, thorns, and prickles. Nature has provided these active conductors, and in them we are enabled to trace the origin of the dew,—a phenomenon which, by blind custom and subserviency to theory, has been ascribed exclusively to the radiation of heat,—thus mistaking an *effect* for a cause. In France, however, it appears that M. Dutrochet has given it as his opinion, “*that the motion of fluids in plants, depends upon two currents of electricity, setting with very unequal force between the denser fluid of the tree, and the lighter fluid of the soil; the more powerful current setting from the soil to the tree, and so producing absorption, by conveying aqueous particles into the roots, through the vegetable membrane of the epidermis*” (or cuticle). We trace the progress of true science in this novel, and more than plausible hypothesis: it does not, it is true, say enough; but it says a great deal. M. Dutrochet subsequently abandoned his electrical theory. I regret this, and so did his friend the late President, Mr. Knight; but the candour of this zealous and enlightened man must be admired. In our own country, another opinion has been advanced in a letter, addressed in November 1827, to the editor of a late periodical register: its subject was “the relation between electricity and vegetation.” The writer advocated the theory, that vegetation is continually extracting electric influence from the atmosphere: that vegetables, as well from their structure, as by the nature of their juices, are peculiarly adapted to act with the greatest efficiency, in imbibing the effluvia; and that it is highly probable they are indebted to its influence for their vitality. This letter is well written, and the arguments of the writer are luminous, and ably supported. It is inserted at full length at the end of the second section on vegetable physiology; where it stands conspicuous as one of the main supports of the system to be therein and elsewhere advocated.

*The Magazine of Natural History*, originated by Mr. Loudon,

contains a proof that the belief of the active influence of the electric fluid in the work of vegetation is rapidly gaining ground. In the 281st page of No. III. under the head "*France*," we find the following extract from the *Bulletin des Sciences Naturelles*, on the *Electric Attraction of Leaves*. "The influence of electricity on organized nature, both animal and vegetable, appears to be better understood. The state of the atmospheric electricity is well known to exert a very marked influence in man, in respect of health and disease; and it is a considerable step in the explanation of the sources of this, which has been ascertained, if not discovered, by M. Astier. His experiments have led him to conclude, that the leaves, the hairs, the thorns, &c. of plants, tend to maintain in them the requisite portion of electricity; and by drawing off from the atmosphere what is superabundant, that they also act, in some manner, as thunder-rods and paragrêles. In one of his experiments, M. Astier insulated the thorns of growing plants, and upon being exposed to the atmosphere when the electric equilibrium was disturbed, they distinctly affected the electrometer."

On comparing the different authorities which I have collected together in the present paragraph, it will be evident that, till very lately, nothing of moment was known of the operations of this power; its influence, in fact, seems to have been looked upon as only probable: circumstances, however, have arisen, and a few experiments have been recently performed, which have induced some philosophers to conclude, that electricity is not only very actively concerned in the processes of vegetable life, but that vegetables themselves, are most important instruments of conduction, and tend to regulate the state of atmospheric electricity\*. The science of vegetable electricity may then be considered as in its infancy; and therefore, to facilitate its progress towards maturity, and at the same time to guard as much as possible against the danger of mistaking effects for causes, I shall endeavour to trace electricity to its source, with a view to ascertain its origin, its nature, and the laws by which it is governed. This will lead me to bring forward an *electrical hypothesis*, calculated to explain, and that on philosophical principles, most of, if not all, the important phenomena with which nature abounds, and to refer all the grand agencies to one only, efficient, and governing principle.

55. *Source of electricity*.—The *earth* has been usually regarded

\* While we speak of electricity, we must not overlook *magnetism*. Discovery after discovery has been announced, and if the hypothesis, that in magnetism may be traced the origin of *cold*, be established, the science of meteorology will be enriched by a fact, the importance of which is beyond present conjecture.

as the reservoir and source of electricity, and, in a qualified sense, it may, with propriety, be admitted so to be; but from many deep and important considerations, the mind can scarcely be satisfied that the earth is its sole and primary source. The form of our planet, its movements, and the various phenomena of attraction, gravitation, the vicissitudes of the seasons, and mutations of the weather, which are attendant on, or result from, these movements, seem to point it out as a recipient rather than as a generator,—as a body acted upon, rather than as one acting.

To the *sun*, the centre of the system, we then must turn our attention, as to the great fountain of light and heat, the source of warmth and vital energy to the whole planetary system; to the animal, as well as to the vegetable creation.

56. *Nature and constitution of the sun.*—Philosophers have been much divided in their opinions, not only with respect to the nature and constitution of the body of the sun itself, but also to those of the light and heat transmitted in its rays. “Some,” says Dr. Hutton, “have considered the sun as a body of fire: they say he shines, and his rays collected by concave mirrors, or convex lenses, will burn, consume, and melt the most solid bodies; or else convert them into ashes or glass. The sun’s rays produce the effects of fire, consequently, the sun is a fiery substance.”

Sir Isaac Newton and others believed that the rays of light are composed of particles which act upon the minute constituent parts of bodies at indefinitely small distances; that by reciprocal attractions, and by being reflected and refracted, they excite a vibratory motion in the component particles. This motion increases the distance between the particles, and thus augments the bulk, and causes expansion;—a certain characteristic of fire. This expansion, which is a beginning of disunion of the parts, being increased by the increasing magnitude of the vibrations proceeding from the continued agency of light, the particles of bodies at length vibrate beyond their sphere of mutual attraction, and thus their texture will be altered or destroyed: from solid it may become fluid, as in melted gold; from fluid it may be dispersed in vapour, as in boiling water.

“Others, as Boerhaave, represent fire as a peculiar substance *sui generis*, unalterable in its nature, and incapable of being produced or destroyed; naturally existing in equal quantities in all places, imperceptible to our senses, and only discoverable by its effects, when by various causes it is collected for a time, in a less space than that which otherwise it would occupy. This matter of fire is not supposed to be derived from the sun; the solar rays, whether

direct or reflected, being of use only as they impel the particles of fire in parallel directions."

"De Luc (*Lettres Physiques*) considers that the solar rays are the principal cause of heat, but they heat such bodies only as do not allow them a free passage. He does not admit the emanation of any luminous corpuscles from the sun or other shining substances, but supposes all space to be filled with an ether of great elasticity and small density; and that light consists of the vibrations of this ether, as sound consists of the vibrations of the air."

57. "*Dr. Herschel supposes the sun to have an atmosphere* resembling that of the earth; and this atmosphere to consist of various elastic fluids, some of which are of shining brilliancy, while others are merely transparent. Whenever the lucid fluid is removed, the body of the sun may be seen through those which are transparent. All the phenomena of the spots, of the faculæ, and of the livid surface of the sun, concur to establish the existence of a solar atmosphere of a very considerable extent."

Dr. Herschel, by many interesting experiments on the nature of the sun's rays, has firmly established a fact which had long been disputed; namely the separate identity of light and heat; that they are both subject to the laws of reflection and refraction; that they are each of different refrangibility, are liable to be stopped in certain proportions, when transmitted through transparent bodies, and to be scattered on rough surfaces. He discovered, also, that the most refracted rays of light—the *violet*, possess the lowest heating power; and the least refracted—the *red*, the greatest heating power; and the mean rays of the prismatic spectrum showed an intermediate power. Thus in the red rays, by an average of experiments, the thermometer rose  $6\frac{7}{8}$  degrees; in the green rays,  $3\frac{1}{4}$  degrees; and in the violent rays, 2 degrees.—(HUTTON'S *Math. Dict.* —'Sun.')

58. *Composition of the sun's rays.*—Each beam of light, as it comes from the sun, seems to be compounded of all the kinds of rays mixed together; and it is only by separating them by means of a glass prism, that the different sorts become observable. The heating power increases from the middle of this prismatic spectrum to the red ray, and is greatest even beyond its visible boundary. Hence it is inferred, that the rays of light and heat nearly accompany each other, and the rays of heat exist in the different proportions above noticed. When the rays are transmitted through a transparent body, the rays of light pass on undiminished, but the rays of heat are intercepted. When the sun's rays are directed to an opaque body, the rays of light are reflected, but the rays of heat are absorbed and

retained. From observation it appears, that the solar rays are of three kinds;—first, rays which produce heat; second, rays which produce colour; and third, rays which exert a chemical action, and deprive metallic substances of their oxygen. The first set of rays is in the greatest abundance, or are more powerful towards the red end of the spectrum, and are least refracted. The second set are those which illuminate objects, and are most powerful in the middle of the spectrum. The third set produce the greatest effect towards the violet end, where the rays are most refracted. The solar rays pass through transparent bodies *without heating them*; the atmosphere, for instance, receives no increase of heat by transmitting the sun's rays, till these rays are reflected from other bodies.—(*Idem*—‘*Ray.*’)

It is also proved that convex lenses receive no heat, although they transmit the solar rays; which by this means may be made to produce a most intense degree of heat. It has likewise been ascertained, that small particles of steel, placed *in the violet ray*, become *magnetic*.

59. It will be curious, and afford a subject for interesting reflection, to compare these philosophical observations of the moderns, with the following passage from a celebrated French author, on the *ethereal fire of the ancients*.

“The action,” says he, “of the sun upon terrestrial bodies having first led them to consider its substance as pure and elementary fire, they made it the focus and reservoir of an ocean of igneous and luminous fluid, which, under the name of *ether*, filled the universe and nourished the beings contained therein. They afterwards discovered, by the analysis of a more accurate philosophy, this fire, or a fire similar to it, entering into the composition of all bodies, and perceived that it was the grand agent in that spontaneous motion, which in animals is denominated life, and in plants, vegetation. From hence they were led to conceive of the mechanism and action of the universe, as of a homogeneous WHOLE, a single body, whose parts, however distant in place, had a reciprocal connexion with each other; and of the world as a living substance, animated by the organical circulation of an igneous, or rather electrical fluid, which, by an analogy borrowed from men and animals, was supposed to have the sun for its heart.” “The more,” (says the author, in a note) “I consider what the ancients understood by *ether* and *spirit*, and what the Indians call *akache*, the stronger do I find the analogy between it and the electrical fluid. A luminous fluid, principle of warmth and motion, pervading the universe, forming the matter of the stars, having small round particles which insinuate themselves

into bodies, and fill them by dilating itself, be their extent what it will: what can more strongly resemble electricity?"

60. *Nature and properties of the sun's rays.*—I have brought forward these various authorities for the express purpose of ascertaining, as far as it might be possible, the real nature of the sun's rays, and how far experiments have furnished data whereon to ground a rational hypothesis; and it appears evident, I think, that the sun's rays are primarily composed of *light* and *magnetism*; or, in other words, that these two principles are existent in, and are primary components of, the sun's direct rays. *Heat* is doubtless produced by the rays striking the earth, or other opaque bodies; but it is by no means proved to exist as a component or primary principle of the rays:—in fact, heat appears in almost every instance to be merely an effect, resulting from a powerfully exciting cause. This subject will be investigated more at length in the section on *Light and Heat*. (May.)

Of the existence of *electricity* in the sun's rays; that is, electricity in the usual acceptation of the term, we have no evidence: experiments have as yet afforded no proof of the presence of such electricity; nor have any phenomena, purely electrical, been observed in the sun's rays; the origin of the electric fluid, therefore, remains so far unaccounted for.

61. *Electrizing principle of the sun.*—A vast variety of facts seem, however, to furnish evidence, amounting almost to a demonstration, that the sun is the source of all the electric phenomena, and that his beams contain an electrizing principle, which, when brought into action in a proper medium, leads to the formation and developement of that specific fluid which we term electricity. It is scarcely necessary to insist upon the well-known fact, that thunderstorms and other electric phenomena are traced to the influence of the sun in summer; every one must be fully aware of the frequency of summer evenings' lightning after very hot days; but there are other circumstances, less notorious, indeed, but not less worthy of attention, which demonstrate that the sun exerts an energy of a peculiar character, and which is altogether distinct from that of mere heat.

62. *Sun's influence upon Vegetables.*—If any one carefully observe a garden-bed of vegetables,—one of brocoli for instance,—the plants will be seen to stand firm and erect, the leaves well poised, and their stems elastic, till towards the hour of noon, or probably an hour or two earlier, according to the season: then, and during four and five of the afternoon hours, the leaves become flaccid and droop; but they revive again as the evening approaches, however dry the

weather may be ; and these effects may be traced during the autumn, and long after the great power of the sun has declined\*.

If some plants, particularly those of the voluble or twining tribe, be gathered at, or soon after mid-day, they droop almost instantaneously. In the month of August, 1828, I pulled up a stem of the black bind-weed, (*Polygonum convolvulus*) which was growing in a strawberry-bed : it was scarcely out of the ground, before, to my astonishment, I observed that every leaf and footstalk was dropping: not a drop of sap had oozed from it, nor had any pressure been made on its stem ; yet it faded almost instantly.

This, and many other facts which might be adduced, tend to prove that there is a downward or descending current during mid-day hours, which does not prevail towards evening and during the night ; at which times the ascending current prevails. Naturalists have remarked, that the sap does not flow so powerfully during mid-day, especially during the summer months, as it does in the night ; and it is a common observation, that culinary vegetables should not be gathered, or cut, when the sun shines hot upon them, as they are then tough, and less juicy than if cut early in the morning. The fact, however, must not be disguised, that transpiration takes place during day-light, and in some instances to an extent that is truly surprising. I noticed in the summer of 1834, during a very sunny forenoon, the effect produced by some leaves of a Hamburgh vine, the under-surfaces of which almost reposed upon, though they did not touch, the upper surface of a leaf of *Musa coccinea*: the water stood in drops upon the latter, but none was seen in the afternoon. Perspiration will therefore account, in a degree, for some of the appearances of flaccidity ; but these are so various and anomalous, that we must refer them, in a great degree, to the operation of other attractive causes !

63. "*The influence of the different solar rays*," says Sir Humphry Davy (*Agricultural Lectures*), " has not yet been studied, but it is certain that the rays exercise an influence independent of the heat they produce. Thus, plants kept in the dark, in a hot-house, grow luxuriantly, but they never gain their natural colours ; their leaves are white and pale, and their juices watery and peculiarly saccharine." —According to Knight, they merely expend the sap previously generated under the influence of light. If we consider the various phenomena produced by a wet summer,—such, for instance, as those of 1828 and 1829, we shall find that the principles of *growth* are in active operation ; and, consequently, that the branches of trees

\* I noticed these appearances on the 30th November, 1828,—a cloudy day, thermometer about 52°.

and shrubs, and the stalks and leaves of herbaceous plants, acquire a rank and luxuriant growth; while, on the contrary, the principles of *maturation and fructification*, are comparatively inactive and imperfect:—thus, the ears of corn, in such seasons, are found to be deficient in their yield, and inferior in their quality: seeds of many kinds of plants frequently do not ripen at all; and fruits are watery and defective in flavour. These phenomena and results, may be philosophically accounted for upon the theory that, vegetable development and maturation depend upon the action of two currents: the ascending current, propelling the sap through the sap-vessels, and promoting the increase and growth of the green and more purely herbaceous parts of plants; while the descending current, or that produced chiefly by the influence of the sun's rays, elaborates the proper juice, the aroma, and other specific and compound products, and carries them downwards from the very extremities of the leaves to those of the root. I speak *generally* in this place; there are other extremely beautiful and curious phenomena constantly exhibited in the vascular system of plants, which will be noted particularly hereafter. The influence of the sun is exercised in a very peculiar manner upon flowers and the organs of fructification, proving that there is a distinct system of vessels exclusively employed in perfecting these parts, but which are stimulated by opposite influences; for, while the leaves of herbaceous plants are depressed and rendered flaccid by the sunbeams, the flowers of the same plants, at the same moment of time, expand their petals, and stand erect and firm by the influence of these very beams. Thus, it appears, that in *wet summers*, that principle or influence prevails, which causes the ascent of vapours, and covers the heavens with clouds, hiding or obscuring the genial and maturing light of the sun's rays; while, at the same time, it produces a great degree of activity in the ascending current through the sap-vessels of plants, which forces them to run into long, unsightly haulm, or rank, luxuriant herbage; and renders all their proper juices watery and immature.

On the contrary, in *dry summers*, the beams of the sun falling upon the leaves, &c., and being absorbed and elaborated by their vessels and cells, render all the proper juices mature, aromatic, and full of flavour; but circumscribe the growth of the merely herbaceous parts. They also stimulate all the vessels peculiarly appropriated to that most important work,—the perfecting, or bringing to maturity, the flower, seed, and fruit.

Great heat, during May and June, attended with aridity, is very inimical to fruit: of this we had ample proof in 1835, in the wretched and stunted product of the apple-trees after the extreme

heat of the third week of June, wherein the mercury rose from 82 to 88 degrees. In 1825,—that memorably hot summer, peaches fell from the trees about the period of “stoning!”

64. *Sun's influence upon the Animal Creation.*—The influence which the sun exerts upon the human frame and the animal creation in general, is strikingly coincident with that which it exerts upon plants and vegetables. Medical men of observation, particularly those who devote their attention to the symptoms arising from a deranged state of the organs of digestion, cannot fail to remark the characteristic expression of the countenance which indicates the sensation of a peculiar debility, experienced at, or rather before noon, and for some succeeding hours. Many dyspeptic persons, particularly those of weak and irritable nervous construction, are well aware of a prostration of mental and bodily strength, which can scarcely have any other origin than that of some powerful external cause acting through the medium of the nervous system, and which, at times, induces a complete alteration in a man's views and intentions; insomuch, as to render him a different or distinct being to himself, in his own internal feelings, at some hours of the day, from what he is at others. Persons, even in comparatively sound health, experience the effect which is regularly produced by the influence of the sun during a few of the mid-day hours:—it is not mere lassitude occasioned by *heat*, it is not debility from indisposition, but a relaxation, or privation of energy, and a disinclination to exertion of any kind, as remarkable for the peculiarity of their attendant sensations, as for the periodical regularity of their recurrence and abatement.

They, indeed, who constantly enjoy a high and robust state of health, may not be able fully to appreciate the truth of these remarks; nevertheless, they may readily ascertain the general fact, that, about the hours alluded to, there is a quietude throughout nature; and, in man, an abatement of that hilarious buoyancy of spirits which is experienced by the healthy, during the early morning, and again in the evening.

65. Many who are intimately acquainted with the HABITS OF ANIMALS—as, for instance, coachmen and travellers, who have continual opportunities of observing the actions and habits of horses, may remark a quietude, or even langour, which is not apparent in the earlier and later hours of the day. Some horses almost invariably indicate, when on a journey, an absolute debility during the afternoon; but they rally, and regain spirit and vigour in the evening. Other horses may not manifest any great degree of languor or debility; yet, though they appear not to suffer, they evince but

little of that fire and high spirit which they possessed in the morning, and recover with the return of the evening. The effect of the mid-day hours upon domestic fowls is remarkable: they become quiet, their feathers hang down, and if possible, they take a kind of "Siesta," perching upon a paling, a hurdle, or upon any convenient rail that the farm-yard may afford. Many of these effects are not by any means confined to hot or moist seasons: they are produced as well during the frost of winter, as during the high temperature of summer. The foregoing are a few only of the multitude of facts which might be adduced, and which have led me to conclude, that all electrical phenomena depend upon the action of the sun's rays; they do not indeed demonstrate that these rays create electricity, but they afford evidence of *a power in constant operation* throughout nature, producing effects which seem to point to remote causes that have hitherto been but little suspected. These effects, if viewed in connexion with the phenomena of the earth's magnetism and electricity, and with those ascribed to gravitation, display a grandeur of simplicity which tends to satisfy the mind that there is indeed *one great exciting principle*, to the influence of which the phenomena of nature may be ultimately referred. What this power really is, and what the nature and extent of the energies which it exerts, may be rendered more apparent by the following hypothesis, or

#### ELECTRICAL THEORY.

66. The sun is either a solid body of luminous matter, or it is a body surrounded by a luminous atmosphere, containing in itself the elements or principles of light, magnetism, electricity, and heat. These elements reach the earth in rays or beams, which furnish direct evidence of being primarily composed of light and magnetism: they also contain *electrizing and calorific principles*, which, when brought into action in an appropriate medium, produce and develop *electricity and heat*. The rays of the sun are also, under certain circumstances, refracted, reflected, and absorbed, but are never lost or extinguished; every particle being devoted and applied to the effectuation of a specific purpose.

Among the chief and most important media of conduction and absorption are *vegetable organized beings*,—trees, shrubs, and herbs, of all descriptions; and, by this process of absorption, the most beautiful phenomena are operated.

Plants abound in pointed terminations, and contain a vascular system, composed of vessels and cells abounding with juices, which qualify them to become the recipients, and most ready and perfect *conductors* of electricity in any of its specific modifications. The

solar rays thus absorbed during their passage through the vegetable organs become themselves decomposed, while they effect many electro-chemical changes in those organs. Thus, the rays of *light* are laborated in vessels of the flowers and leaves expressly adapted to the processes of separating and fixing the colouring principle. Other portions of the solar rays serve to stimulate the glandular and other vessels of the leaf, and to produce and propel the proper juices of the plant, which are then carried down through the returning vessels of the bark, or deposited in appropriate vessels of the cellular system. The whole of the unabsorbed or undecomposed rays pass downward to, and through the roots, and thus constitute the *descending current of solar vegetable electricity*. Each individual specific process is performed by specific means: each particle of the rays is devoted to a specific purpose; and the combinations and decompositions are effected by organs specifically adapted to the express purpose, and to no other; all in beautiful harmony, and all in accordance with the purposes of infinite wisdom.

The surface of the earth is another grand medium of absorption. It receives the direct rays of the sun; one portion of which is reflected, another is absorbed, and becomes the great agent in effecting the electro-chemical processes which are carried on within the earth's surface; during and by which, the decomposition of water, the oxidation of metals, the formation of gaseous bodies, and other great natural phenomena, are uninterruptedly, and for ever induced. It is, as I conceive, during the induction of these phenomena, that the *electrizing process*, is begun and perfected; and that, not only by the decomposition of the sun's rays themselves, but also by an energy which they exert upon matters within the earth's surface; and the results of this electrizing process are the separation of the principle of *magnetism* and the formation and developement of *heat* and of *electricity*.

The electricity so developed is distributed—if not through the mass, at least over the surface of the earth; and, in this sense, the earth may be considered as “the reservoir both for the supply and absorption of electricity.”

If the foregoing theory be correct, the phenomena which it contemplates approach those of the Voltaic electricity, though they are conducted on a scale infinitely more grand. Dr. Faraday's *New Researches* in electricity tend to throw much light upon the subject of the immense volume of that fluid which is distributed throughout matter.

But *magnetism* must not be overlooked! Is it identical with, or a modification of electricity? At all events, it evinces peculiar

powers—which remind us of the plus and minus, vitrious and resinous qualities of the old electricians. Perhaps the day is not far remote, when these two grand ethereal agents will be found to interpret the phenomena of positive and negative electricity!

67. Such are the principal points of the electrical theory, by which I propose to explain the various natural phenomena that may come under consideration in the course of the work. In the mean time I would observe, that although some authors appear to have entertained ideas which, if they had been closely followed up, might have led to a well digested hypothesis; yet it should seem, that from hesitation, or the absence of internal conviction, they have invariably stopped short of arriving at any definite conclusion. Thus, Dr. Thompson has observed that there seems to be a close analogy between *caloric* and *electric matter*:—"Both of them tend to diffuse themselves equally, both of them dilate bodies, both of them fuse metals, and both of them kindle combustible bodies. I do not mean to draw any other conclusion from these facts, than that electricity is very often concerned in the heating of bodies, and that probably, some such agent is employed in accumulating the heat produced by friction. Supposing that electricity is actually a substance, and taking it for granted that it is different from caloric, does it not in all probability contain caloric as well as all other bodies?" &c., &c.

Dr. Hutton appears to have entertained more sublime and comprehensive ideas; for he closes his article on "Electricity," (*Mathematical Dictionary*,) with these words: "Perhaps we may be allowed to enlarge our views, and consider the sun as the fountain of the electric fluid, and the zodiacal light, the tails of comets, the aurora borealis, lightning and artificial electricity, and its various, and not dissimilar modifications."

Other authors may perhaps have approached still nearer to the electrical theory which I now advance, but I am not aware of that being the fact: nor that any one has ever, or in any way alluded to the formation and developement of the electric fluid, by the decomposition of the sun's rays within the surface of the earth. I think also, that I have placed in a new point of view, the phenomena of the ascending and descending electrical currents through the vessels of plants. I disclaim the idea of building upon any man's foundation; but while I do this, I cannot but claim as my own, all that I conscientiously believe to be such, till I be convinced that others have had a just, and prior claim to originality\*.

\* The reader versed in the French language, is invited to peruse the various profound articles by M. Becquerel, and others, that have recently appeared in *Les Annales de Chimie et de Physique, par Gay Lussac et Arago*. April, 1831, &c. &c.

Much remains to be said on the application of the theory, in explanation of the phenomena produced by electro-chemical agency; but the subject must be referred to the sections on water, on heat, and on the atmosphere; in which I hope to produce satisfactory reasons for believing that *chemical action* of every kind is effected by *electric agency*, and that in every case where *electrical* phenomena are discerned, *chemical affinities* are either induced or regulated. In the mean time the reader's attention must be directed to the consideration of a few of the ordinary laws of common electricity, without which consideration, the present section would be left in an unfinished state.

68. These electrical laws are usually classed under the following heads: namely, *Excitation, Attraction, Repulsion, Distribution, Induction, and Transference*; it will suffice to consider attentively the operations of the laws of *Induction* of electricity, because they include, and are intimately connected with, some of the phenomena of attraction and repulsion.

By the term *induction*, is to be understood that law or principle, by which a body charged with electricity although perfectly insulated (or cut off from direct intercourse with another body by means of non-conducting substances,) tends to produce an *opposite* electrical state in all bodies in its vicinity, or within the range of its influence: "thus the vitrious or positive electricity tends to produce the resinous or negative electricity in a body that is situated near it; and this with greater energy as the distance is smaller. This effect is termed the *induction* of electricity."

"If an electrified body charged with either species of electricity be presented to an unelectrified or neutral body," (but without touching it,) "its tendency, in consequence of the law of induction, is to disturb the electrical condition of the different parts of the neutral body. The electrified body induces a state of electricity contrary to its own in that part of the neutral body which is nearest to it; and consequently a state of electricity similar to its own in the remote part. Hence, the neutrality of the second body is destroyed by the action of the first; and the adjacent parts of the two bodies having now opposite electricities, *will attract one another*." (See *Treatise*, No. 37, 38.)

69. It is of the utmost consequence that this most influential law of induction should be clearly understood, and that the nature of the energy which it exerts, should constantly be kept in view: because on it, in all probability, depend not only many of the grandest phenomena of nature, but also those which result from the "play of chemical affinities," and these are intimately connected

with the processes of fermentation and solution, on which chiefly depend the preparation of vegetable aliment. It appears certain that the agency of induction is in constant operation, and that no limits can be set to the *extent* of its agency; that by it, electricity is accumulated in bodies; and that the quantity of electricity which a body may contain, depends upon the extent of its surface more than on the bulk of its solid contents. It moreover appears certain, that the *spherical form* is the one most favourable to the retention of the electric fluid in bodies, while on the contrary, *points* tend to effect its most rapid dispersion. *The Earth and Moon* are of a form almost spherical, and there is little doubt that electricity is distributed over their surfaces, and is maintained and renewed (possibly in *specifically* distinct modifications) by the electrizing principle of the sun's rays. With these considerations, will it not be reasonable to pause, and enquire whether an agent like electricity, so subtle, so powerful, so susceptible of infinite modifications; the *reality* of whose existence is undeniable, and the nature of whose phenomena admits of absolute demonstration by experiment; whether such an agent be not capable of producing all the phenomena which are usually ascribed to *gravitation*; whether it may not govern the movements of, and regulate those attractions between a planet and its satellite, on which depend the vicissitudes of the seasons, the alternations of day and night, and the ebbing and flowing of the tides? *Electricity*, as has been observed, is known to exist; it is known to be more or less in a state of constant operation; in a word it is a *cause* producing *effects*. *Gravitation*, on the contrary, is a conventional term for an *effect*—certain, indeed, but resulting from no known cause. We have then to decide, whether it be the more philosophical to admit that, so tremendously powerful an agent as electricity, is capable of inducing all the effects ascribed to gravitation, or to remain satisfied with the assumption that bodies gravitate solely, because by the law of their creation they tend to fall towards a centre; or, “that every particle of matter in nature gravitates, or tends towards every other particle!”

70. Little more remains to be said in this section; but if we may be permitted to extend our views, and to suppose that the sun's electrifying power operates upon all the planetary bodies, and establishes their primary and secondary electrical relations, which act and re-act one on the other;—if moreover, we conceive the probability of a mutual interchange of influences existing between the sun and his planets, and that he attracts and receives from them that matter which supports and renews the luminous fluid that composes his *own rays*; how vastly comprehensive will appear the mighty plan

of operations—a plan by which not even a *particle of light*, ever is or shall be lost!

Comets have by some been supposed to regulate the electrical relations between the sun and the planets; and by others, to supply the loss which the sun sustains by emitting rays of light and heat. I am inclined to believe that the agency and influence of induction and attraction are universal and complete; that a reciprocal and harmonious interchange is for ever going on between the sun and the planets, the sun itself being the “one great principle” which operates, and “connects together all the phenomena of the material world\*.”

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## SECTION II.

### NATURAL HISTORY AND CULTIVATION OF ESCULENT VEGETABLES.

#### PART I.

#### OF THE FUSIFORM, OR SPINDLE-ROOTED TRIBES.

Subject 1. THE RED BEET:—*Beta vulgaris*. *Chenopódeæ*. Class v.  
Order ii. *Pentandria Digynia*, of Linnæus.

71. *The red Beet* is a biennial, with large, oblong, succulent leaves, of a dark red or purple colour. In the second year, it sends up an erect stem, bearing greenish flowers, which have no corolla,

\* A few days subsequently to the completion of the foregoing section, I met with a notice in some of the public prints of Professor Leslie's *Theory of the internal constitution of the Earth*, wherein he states the opinion, founded on experiment, that the globe must be hollow or cavernous: the central cavern being of necessity filled with a substance of vast repulsive power; to which cavern the surface is as it were, a mere crust or shell, bearing but a small proportion to the diameter of the sphere. There is but one substance which appears to possess the necessary elasticity; and that substance is light in its most concentrated state, “which, when embodied, constitutes elementary heat or fire.” It may be impossible to prove or disprove the truth of the theory. Be this as it may, it by no means impugns the hypothesis which I have advocated: on the contrary, it is in complete unison with the views I entertain of the universal agency of induction. Assuming then, for the sake of argument, that Professor Leslie's theory is correct, and that the centre of the globe is cavernous and replete with condensed light, “shining with intense refulgence and overpowering splendour”; I still insist that, *that light* is derived—not intrinsic: that its source is the *sun*; its nature *electrical*; and that it is a result of the electrising process before described;—the centre of the earth being the depository of a laborated fluid, destined to perform the most important offices in the economy of nature.

but a calyx of one leaf, cut into five segments, it is fleshy at the base, and permanent; and in it the kidney-shaped seeds are embedded, the segments closing over them. The root is of a deep red colour, and sometimes a foot or more in length, and from two to four inches in breadth. "The red beet," says Loudon, "is a native of the sea-coast of the south of Europe, and was cultivated in England as far back as the year 1656." The roots, to be rendered easy of digestion should be boiled till perfectly tender, when they may be eaten warm as a dinner vegetable; or they may be sliced and used with salads; or if the slices be covered with vinegar, they form a delicious kind of pickle, of a most beautiful colour; and which will keep good for several days.

72. *Varieties and soil.* There is only one species, but about seven varieties, the principal of which are,—

1. The long rooted, which should be sown in deep sandy soil.
2. The short rooted, purple-leaved.
3. The green-leaved, red-rooted, requiring a depth of soil equal to that for the long rooted:—all the varieties are best cultivated in ground that is deep, very fine, rather sandy, and dry; rich and mellow, but by no means manured with fresh rank dung.
4. Beta cyclo, or silver beet; the leaves only are eaten as spinach.

73. *Sowing and culture.*—Beet should be sown annually, about the middle or latter end of March, or early in April, if designed for autumnal use; but in the beginning of May, if intended to come in the next spring. Let the ground be manured with light, *sandy* compost, but never, as has been said, with rank dung; or, what is far better, trench the plot eighteen inches deep, and lay three inches of strong manure at the *bottom* of each trench, to attract the tap root, and bring it down in a perpendicular direction. In filling the trenches, remove large stones, and pulverize the ground, making it as fine as possible; do this a month or two before sowing. At the time of sowing, set out the beds according to the number of the rows required. Stretch the line, and draw an even drill with the point of the hoe, about an inch and a half deep; drop two or three seeds either at regular distances of eight or ten inches in the drill; or drop single seeds about two inches apart all along the drill; then draw the earth which the hoe raised, back again over the seeds, and press it down firmly and hard, with the spade. Proceed thus, making rows one foot apart for the smaller sorts, or eighteen inches for the long rooted:—three or four rows will be sufficient for one bed. Cut the edges of the bed evenly by the line; each edge to be at least nine inches from the outermost drill; and then, form little foot paths on each side of the bed. When the plants come up, and make some

little progress, thin them out, so as to leave only one of the strongest in each spot, and eight or ten inches apart. *Beta cyclo* will require yard spaces.

Beet will transplant; but the operation appears to reduce the size of the root. Keep the rows free from weeds by flat hoeing between the drills. Some of the roots may be ready for use in September;—and in October or November, dig up the beets; cut off the leaves a little above the crown, and let the roots be preserved in dry sand, for use during winter.

Be careful not to injure or cut the roots, because they bleed much; and it is for this reason, that the leaves should not be cut close to the tops. From Sir H. Davy's analysis, it appears that 1000 parts of the red-beet contain 148 parts of *nutritive* matter; of which 14 parts are mucilage, or starch; 121, saccharine matter, or sugar; and 13, gluten, or albumen.

74. *To save the seed*, transplant a few of the best roots; place them in a convenient spot apart from the varieties of the species: they will flower the second year; and the flower stem should be tied up to stakes till the seed be ripe. Cut down the stalk, lay it on a cloth exposed to the sun, or under an airy shed, till perfectly dry: then, separate the seed vessels, and preserve them in paper bags, in a cool room, free from damp. These directions will apply equally to carrots and parsnips. Beet seed, if dry, will germinate when eight or ten years old; but the seed of the two latter, should not be trusted after the first year.

Subject 2. THE CARROT. *Daucus carota*. *Umbelliferæ*. Class v.  
Order ii. *Pentandria Digynia*, of Linnæus.

75. The *Carrot* is an umbelliferous plant; its seeds are elliptic-oblong, compressed transversely; with four rows of flat prickles, and rough intermediate ribs; calyx obsolete; petals inversely heart-shaped, unequal; flowers separated. It is a biennial, a native of this country, growing plentifully by road sides; and from the appearance of the umbels, which sometimes become concave, the flower has obtained the name of "bird's nest." The leaves are alternate, on broad, concave footstalks, bi-pinnate, cut, narrow, and distinctly hairy: the root is of a red-yellow, or pale straw-colour. A white variety has lately appeared.

76. The *chief garden varieties* are, the *early horn*; a short, small root, for early crops; which may be sown from the last fortnight in February to the middle of March, if dry, open weather occur. These first sowings may require a shelter of haulm or fern leaves, occasion-

ally, in the event of severe frost, and cutting wind. The second variety is the *orange or long carrot*, for the main crop; it is to be sown from about the second week in March to the third week in April;—these two varieties are sufficient. Succession sowings for drawing as young carrots throughout the year, may be made in May, June, July, and August.

77. *Culture and Soil*.—The seeds being armed with forked hairs, and clinging together, should be mixed with an equal quantity of sand, a little moistened, and rubbed between the hands, in order to detach the seeds from one another. For a bed of thirty feet long, and four and a half feet wide, one ounce of seed may suffice. Choose a warm border for the very early sowings, but for the main and succession crops, let the beds be in the open ground. Proceed in every respect according to the directions given for the beet root; but the drills need not be quite so deep, or further asunder than ten inches. Scatter the seeds evenly along each drill; and do this in calm weather, as they are very light, and liable to be dispersed by the wind. To allow for the destruction which the fly may occasion, sow the seeds pretty thickly. When the plants have attained two or three inches in height, thin them with the hand; those that are intended to be drawn as young carrots to four or five inches apart; but those that are to stand for the main crop, to eight inches. Keep the plants free from weeds during their growth, by occasional hoeings with the dutch hoe. Carrots prefer a light, sandy soil, and this should be prepared eighteen inches deep, with the manure at bottom. It should be *as fine as possible*, and free from roots and stones, as these interrupt the perpendicular descent of the carrot, and force it to branch, or take a spiral growth. Take up the roots late in autumn, and keep them in dry sand.

According to Sir H. Davy's analysis, 1000 parts of carrot contain only 98 parts of *nutritive* matters, of which 3 parts are mucilage or starch, and 95 saccharine matter or sugar.

Subject 3. THE PARSNIP. *Pastinaca sativa*. *Umbelliferæ*. Class v.  
Order ii. *Pentandria Digynia*, of Linnæus.

78. The *Parsnip* is an umbelliferous plant, a native of England, and, like the carrot, a biennial. The seeds are elliptic-ovate; calyx very minute, obsolete; petals yellow, lanceolate, involute and equal; flowers regular, uniform, perfect. The garden parsnip has large, smooth, pinnated leaves, of a light green colour: the roots are white or cream colour; mild, sweet, and aromatic.

79. *Culture and Soil*.—The directions for beet-root and carrot

are equally applicable to the parsnip; the seed must be new, that of the last year's production. It may be dropped into holes an inch deep, made along a line with a blunt dibber, and then covered with the earth. The period of sowing is comprised between the last week of February, and the first of May; but the medium is the best; the weather ought to be dry, and the ground in a free, open condition. Make the holes nine inches apart one way, and twelve inches another, and drop four or five seeds into each hole, to be thinned out to one strong plant, when the plants have attained two or three inches in height.

If parsnips be sown in drills, by scattering the seed in the usual way, first draw the earth over the seeds, then press it firmly and evenly with the flat of the spade, and finally rake the beds level and smooth with a fine-toothed rake.

80. *If the ground be naturally stiff and clogging*, let it be well trenched in the preceding autumn, and blended as truly as possible with light sandy compost; then set the ground in ridges, to be mellowed and broken up by the frost. When the sowing time is arrived, try the following method, which is equally applicable to beet and carrot, as to parsnips. Level the ridges, and dig the ground piece by piece, as directed for beet; then strain the line very tight, and, with a strong iron-shod dibber, or round-pointed crow-bar, make holes nine inches apart along the line; work the tool round, till each hole be three inches broad at the top, and of depth sufficient to admit the root of a well grown parsnip quite up to its top: that is, supposing the weak end of the root to have been trimmed off: each hole then will be full twelve inches deep. Fill these holes one by one, with light sandy compost: press it till it feel moderately firm in the hole. Exactly in the centre of this compost, make a smaller hole half an inch deep; drop in four or five seeds, and when one row is sown, dig and prepare another space of ground, and make another set of holes by the line, twelve or fourteen inches distant from the first. As each row is finished, fill up the holes with sandy compost, and press it firmly with the spade, then rake the ground even. The evident object of this mode of proceeding, is to give a perpendicular direction to the roots through the light sandy compost, surrounded as it is by the stiffer ground of the bed, which thus forms a kind of firm sheath to each individual root. The plan is reasonable, and it has been repeatedly and successfully tried. The trouble is considerable at first, but the distances are so true, that, with the exception of the work of thinning out all but one, and that the strongest plant, the Dutch hoe will effect all that need be done in future, with scarcely any trouble or loss of time.

According to the analysis of Sir H. Davy, 1000 parts of parsnip contain 99 parts of *nutritive* matters; of which 9 parts are mucilage or starch, and 90 saccharine matter or sugar. (*Agric. Chem.* 137.)

81. *Uses of the Parsnip.*—Besides the common use of this root, as a dinner vegetable, the *Ency. of Gard.* says, (No. 3724,) “that it was in Catholic times, a favourite *Lent* root, being eaten with salted fish; and that according to Neill, parsnips are often beat up with potatoes and a little butter; and of this excellent mess the children of the peasants in the north of Scotland are very fond, and that they do not fail to thrive upon it. In the north of Ireland, a pleasant beverage is prepared from the roots, brewed along with hops. *Parsnip wine* is also made in many places.” Of this wine, one of the best, and cheapest of the home-made wines, and of the most easy manufacture, I can speak from experience. The process is certainly not one that really belongs to the science, or practice of gardening; but it may be fairly considered one of domestic economy, and as such will be appreciated by the domestic gardener; unless, indeed, where economy is conducted on such rigid principles as to exclude all thought of anything in the shape of pleasurable enjoyment.

#### *Receipt for Parsnip Wine.*

Let six gallons be the proposed quantity: then clean thoroughly, twenty-four pounds of the soundest roots; divide each root into four longitudinal pieces, and cut these long pieces across, so as to reduce them to little pieces of about three inches each. Put these, with about eight gallons of soft spring water, into a copper, or iron boiler; cover the vessel closely, and bring the liquor to boiling; let it boil fully three hours, or till the parsnips become quite tender; try them occasionally, but be cautious not to bruise them; when this is ascertained, remove the fire, and strain the liquor through a hair sieve into a cask or other *open* wood vessel, with like caution not to render it turbid by crushing the roots; add immediately three ounces of the best pale argol (crude tartar of wine) powdered, and stir it well twice or thrice in the course of half an hour; then add firm and good loaf sugar, in the proportion of three pounds to each gallon of the wine to be made; i. e. eighteen pounds in this instance; stir till the sugar be dissolved; leave the cask uncovered till the liquor cool to 75° of the thermometer: if it be kept in a place where the temperature is regularly at about 60°, it will probably ferment spontaneously; but be this as it may, barm or *yeast of beer* is utterly inadmissible, it spoils all home-made wines. A tasteless ferment, or artificial leaven, is readily obtained by boiling two ounces of wheat flour or potatoe starch, one ounce of moist sugar, and about half a quarter of an ounce of salt, in a pint and a half of soft water, till reduced to a pint, stirring the mixture continually; then remove it from the fire, and when cool, bottle and cork it up, and place the bottle in the hearth or other situation, where it may be kept gently warm; it will ferment in twenty-four hours. If there be lees of a previous parcel of wine perfectly fresh and sweet, they will furnish the most natural ferment; but if otherwise, a tea-cup full of the mixture (which should be previously prepared) may at first be added, when the liquor is at the heat mentioned above: now cover the cask, first with a

flannel cloth, and then with the loose head of the cask upon the cloth; stir the liquor twice a day, and if it do not ferment in twenty-four hours, add another cup full of the leaven. In three or four days, turn the wine into a *sweet* and *dry* six gallon cask. If the intention be to make a *sweet or rich wine*, fill the cask quite up to the bung, and let it work over, and be filled up with liquor reserved for the purpose: this will throw off the froth, or product of fermentation; and as soon as the chief *hissing* ceases, bung the cask close, and cover the bung with a mass of moist sand, leaving, however, a vent hole, with a peg closely in it, to prevent accident; but close it as soon as possible. If, on the contrary, a *dry wine* be desired, leave about two inches space in the barrel, cover the bung-hole with a tile, and stir in the froth that rises, and rouse up that which settles, so as to retain and disseminate the fermenting principle, and thus to laborate the sugar as much as possible; close the cask tightly in about ten days, and shake or roll it well once or twice a week for a month; whenever the wine becomes dry, rack off the clear, into a clean and sulphured cask, (that is, one which is filled with the fumes of burning sulphur.) The *les* may be preserved in a glass-stopped bottle, in a cool place for a future brewing. March is the month for making parsnip wine; the wine may be racked in clear weather, about the end of the following December. In March following, it should be fined with a quarter of an ounce of isinglass, dissolved in a pint of the wine, poured into the cask, and stirred round; when it has settled and become bright, rack it again: it will be *better* to keep it, till Christmas following, in wood; but it *may* be bottled as soon as bright, after fining. Bear in mind most particularly, that fining, racking, and bottling must ever be performed in cool, still, and serene weather; all atmospheric commotions are caused by agencies, which instantly affect fermented liquors very perceptibly. These directions will in general apply to all home-made wines; but wines *from fruits* require no artificial ferment or leaven, though they imperatively require to have three times the quantity of pure juice of fruit that is usually allowed, and also the addition of the argol or crude tartar: this appears to be of essential utility to all home-made wines; it gives a quality which approaches to that of a foreign wine, and aids the vinous fermentation.

## PART II.

### OPERATIONS IN THE VEGETABLE GARDEN, FOR THE MONTH OF FEBRUARY.

82. The nature of the weather must still govern the operations of the month: attend therefore to the remarks made under the head of "operations" in the last month. If the weather be mild and pretty dry,—

*Sow*—Beans; the mazagan, long-pod, and Windsor, about the second and fourth week.

Celery; in a box, in heat.

Onions; in a frame, for transplanting.

Radish; short-topped and salmon, twice or thrice.

Cabbage; early York, Ham, or sugar-loaf, to succeed the main crops. Also, a little *red* cabbage; all about the last week.

Spinach; once or twice.

Salad; that is, mustard and cress, every week.

*Plant*—rooted offsets, or slips of mint, balm, sage, rue, rosemary, &c.

*Transplant*—Cabbage, from the nursery beds, for the main, spring and early summer crops: this work may be done whenever the ground works freely, and is not wet and cloddy.

Attend to neatness in every quarter of the garden; and destroy vermin.

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### SECTION III.

#### PART I.

#### NATURAL HISTORY AND CULTIVATION OF STONE-FRUIT TREES.

Subject 1. PEACH-TREE:—*Persica vulgaris*, *Rosaceæ*. Class xii.

Order i. *Icosandria Monogynia*, of Linnæus.

83. The *Peach* is one of our most esteemed fruit trees. The flowers are sessile, *i. e.* without footstalks; seated on the branch, singly, or in pairs; they have five-parted, reddish calyxes, or cups, and bell-shaped, pale or dark red corollas of five petals; the stamens are twenty or more; style simple; standing on a roundish germen, which becomes the fruit, called a drupe:—this is downy, furrowed from the insertion of the stalk along one of its sides; the pulp is firm, succulent, whitish, yellow, or inclined to red; the stone pointed, irregularly and deeply furrowed; and the kernel bitter. The leaves are spear-shaped, glossy, and of a full bitter flavour; of which some persons prepare the liquor called *Crème de Noyau*. It should be observed, that leaves and kernels so flavoured, appear closely to resemble those of the laurel and bitter almond, and yield by distillation an essential oil, which possesses deleterious qualities.

According to Loudon, (No. 4481,) “Sickler considers Persia as the original country of the peach, which, in Media, is deemed unwholesome; but when planted in Egypt, becomes pulpy, delicious, and salubrious.” The peach also, according to Columella, when first brought from Persia into the Roman empire, possessed deleterious qualities, which Knight concludes to have arisen from those peaches being only swelled almonds (the *tuberes* of Pliny) or imperfect peaches; and which are known to contain prussic acid, and to

operate unfavourably in many constitutions. The date of introduction according to the *Hortus Britannicus* was 1562.

84. *Propagation and Culture.* The peach may be produced from the stone; and this mode appears to be much pursued in America, where numerous varieties are raised; but with the view of perpetuating any choice and approved sorts, the operation of budding is resorted to: the method of performing which, will be described in a future section on the scientific operations of gardening. The peach, according to Abercrombie, is budded on plum stocks; occasionally on almonds and peaches, raised from the stones. The budding may be performed in July or August, and, for a dwarf, to cover a wall, at six inches from the ground. The bud will shoot the following spring, and the head of the stock is then to be cut off, a little above it. The bud will probably make a shoot of two or three feet in the first spring; and, in autumn following, the tree may be planted where it is to remain. At a year old, the shoot must, in spring, be shortened to five or six eyes, to force it to make lateral shoots, so as to fill the wall as expeditiously as possible. Authors and practical men differ much in their directions for performing the work of training. Copious quotations will be given in a future number, including a description of the celebrated French method of training at Montreuil. I now confine myself to Abercrombie's plain directions.

85. *Future culture of the peach.* As this tree usually produces its fruit on the young wood of the preceding spring, a regular supply of such wood must constantly be provided for, by careful pruning twice every year. "Begin the *summer pruning* in May or June, and remove all ill placed and bad growths of the year; which, if attended to early, may be effected by rubbing them off with the thumb; but otherwise, you must use the knife, taking off all the fore-right shoots issuing from the front of the branches, and any of luxuriant growths, quite close, carefully selecting a large supply of all the regular side-shoots, or succession bearers, for next summer. Displace all the superfluous or abundant ones, leaving plentifully of the proper shoots to choose out of at next winter's pruning, training them now close and regular to the wall at full length all summer, except observing, in vacancies to pinch any shoot where wood is wanted." "In *winter pruning*, from November to March, un-nail most of the branches, select a proper supply of last summer's shoots for the following year's bearers, choosing the middling strong, best placed ones, to arrange at about five or six inches distance, cutting out the superabundancy close to the mother branches, together with part of the old bearers, down to the first proper shoot they

support,—making room for training the requisite succession of new bearers, which are previously to be shortened, each according to its strength, to promote their producing a supply of future shoots next summer.”

Notwithstanding the prevalence of custom and the weight of authority, I am bound to enter a protest against winter-pruning. Whenever we cut a shoot or branch in the torpid season, we incur the risk of doing serious injury. Let the spring disbuddings, and summer prunings *form* the tree, then wait for the swelling of the buds, and mark the situation of the blossoms. Select those shoots which are prepared to furnish well placed shoots for the next years bearers; and retain blooming shoots according to the size and powers of the tree. When the fluids are in motion, wounds made with a sharp knife heal freely, and the deformity of dead twigs will be prevented.

A preliminary axiom in the art of pruning, and one to be constantly borne in mind, is, that to cut a branch *short*, forces it to produce wood shoots: on the contrary, to leave a branch un-pruned, or to shorten it but little, inclines it to produce *flowers and fruit*, the philosophy of which will hereafter be examined. In the mean time the following concise rules may be considered as certain in their practical result: 1st, to obtain wood shoots, prune short; 2nd, to obtain fruit buds, prune long; 3rd, to check a branch of too vigorous growth, bend it down towards an horizontal position; 4th, to strengthen a weak branch, raise it more towards a perpendicular direction; 5th, to bring a tree to flourish and fill up at the bottom, bend the upper branches and prune them long, and prune the lower ones short. Subject to these rules, as guides to the judgment in *particular* cases, prune generally, each branch, to about two-thirds of its natural length, to a shoot bud, but not to a blossom bud. “Cut either to a shoot bud, distinguished from the blossom buds by being long and thin, and the others round and swelling; or you may prune to a *twin* blossom, which generally furnishes a leading shoot from between. As soon as pruned, let the mother branches and new bearers be regularly nailed to the wall horizontally. In unfavourable springs, when the trees are in blossom, defend on nights in frosty weather with garden mats, or with cuttings of the branches of evergreens furnished with leaves, sticking them between the branches, taking down the mats every fine day, but permitting the cuttings to remain till the fruit is set and out of danger.”—(*Pocket Dictionary*, “*Amygdalus*.”)

M·Phael says, that “in training a tree, whether against a trellis or a wall, it should be spread and divided equally, so that no part

may be left bare from the ground, on each side of the tree, to as far as the tree extends."—(*Gard. Rem.*)

*Fertility*, in every part of the tree, is the chief object of the wise gardener; it is incompatible with absolute preciseness of figure; because nature cannot be constrained to produce bearing wood at all times and in all situations. If therefore, a blank space occur, or a branch fail on one side of the tree, it will be always better to coax without violence a small branch on the other side, so as to bring it over the vacancy; and moreover this bending of the wood produces a fertile condition of the buds.

A new mode of *symmetrical* training invented by a gardener of the name of SEYMOUR, consists in leading up a nine or ten foot wall, *one central stem*, from which branch out lateral shoots to the right and left. From these laterals (which become permanent branches), secondary shoots are trained, but only on the upper side of each: all those which are produced from the lower side, being rubbed off as they appear. The secondary shoots are the *bearers*, and from these, fresh bearing wood is sent forth every year. To form a handsome tree by this new method of training, much adroitness, discernment, and foresight are required: with the exercise of these, a beautiful tree of exquisite symmetry is the result.

86. *Protecting the fruit.* Mr. Cobbett objects to the use of boughs and mats. "Frosts," says he, "descend, that is to say, their destructive effects come down upon a tree perpendicularly. It is not the *cold* that destroys the germ of fruit; it is the wet joined to the cold." "When frosts come without rain, or dews, they do very little harm to blossoms; therefore, the thing to be desired, is something to keep off the wet during the time that the blossom is becoming fruit." He recommends *wood-bricks* to be built into the wall, in the row of bricks next the top row, at suitable distances, and to have holes bored in these wooden bricks, to admit the ends of stout rods, or pieces of iron, about two feet long, exclusive of the part to be inserted; and just before the blossoms begin to burst, these pieces of iron are to be fastened in the holes. Upon these pieces of iron, boards are to be laid along, by the top of the wall; "the boards might be fastened down to the pieces of iron, by holes made in the former, to admit a small cord to fasten the former to the latter; and the whole would remain safe against the power of the winds, until the season arrived when the fruit would be out of danger. The boards might be placed rather in a slanting direction, in order to prevent rains from pouring upon, and running down the wall."

The best and readiest materials for protecting fruit-trees is

*bunting*, or an old flag, of the required length and breadth, let down every frosty night over the tree or trees, and rolled up to the top of the wall in mild, or sunny weather.

87. *Thinning the fruit.* Suffer no single shoot to ripen more than two peaches: commence thinning when the peaches are about the size of small gooseberries, and thin them finally to six inches apart. On this subject Mr. Cobbett remarks: "it is not the producing of the *pulp*, which requires the great effort of the tree, but the bringing of the *seed* to perfection; so that, though you are to have the same weight of peaches on a tree that should bear one hundred, as on a tree that should bear two hundred; still the effort required from the tree would be only half as great in the former case as in the latter; because in the former, there would be only half the number of SEEDS."—(*English Gardener*, No. 278.)

There is something exceedingly curious in this phenomenon; it adds another proof, to the many already existing, that there is a distinct set of vessels appropriated to the maturation of the seed; which, when excited, seems to divert the regular course of the fluids in the vascular system of the plant, and wonderfully to exhaust its energies. I suspect this sympathetic action to be carried on by the agency of electric currents taking a lateral course through the medullary or divergent rays, and that the office, or one of the offices of these rays, is to regulate the sympathies which exist between the vessels of nutrition, and those of fructification.

A very interesting paper is found in the *Annales de Chimie et de Physique*, tom. 46. Fevrier 1831. p. 147, entitled, *Mémoire sur la maturation des fruits*, par M. COUVERCHEL; lise à l'Academie des Sciences, le 10 Mai, 1830.

88. *Varieties and soil.* Loudon enumerates fifty-three varieties of the peach; and afterwards mentions, on the authority of Forsyth, the sorts which may be suitable to a small garden; these are

The early Avant,	Royal Kensington,	Early Chancellor,
Small Mignonne,	Noblesse,	Nivette,
Anne,	Early Newington,	Catherine,
Royal George,	Gallande, .	Late Newington.

The best catalogue of peach and nectarine trees is found in GEORGE LINDLEY'S *Guide to the Orchard and Kitchen Garden*, 1830. The author has been at great pains to classify the trees according to the serratures of the leaves, and the structure of the glands on the peduncles.

The peach flourishes in a soil of good meadow earth, or top-spit loam, enriched with vegetable mould, and mulched at top with dung; and in borders trenched twenty inches deep, and made up with the soil thus composed; on this subject, much will be said in the section on "*forming a new garden*."

### MODE OF ACCELERATION.

Peaches and nectarines grown on the open wall are liable to many casualties, and therefore it becomes extremely desirable to protect the trees more effectually than by mere coverings; and at the same time to accelerate the ripening of their fruit. Both these objects can be accomplished by adopting a plan now to be described.

Let a piece of ground in the proximity of the garden, be excavated about nine inches deep, to admit of the erection of a brick pit twenty-one feet long, and from six to seven feet wide; the front wall should not be more than four flat courses of bricks above the ground-level, exterior of the excavation; which will admit of two courses within it for the foundation. The side walls will slope from the front to the back wall, which should be at least a yard above the exterior level, and thus produce a good bold angle, amply sufficient to carry off water, and obviate drip from the laps of the glass. Four inch work will be sufficient, even for the back wall, which may be pigeon-holed, six courses high. Six lights, supported by rafters let into curbs, of sufficient strength, properly glazed with quarries 6 by 4, or  $5\frac{1}{2}$  by  $3\frac{1}{2}$ , will complete the erection. A trellis consisting of sloping strips of deal, crossed from end to end, by copper wires made to pass through each slip, nine or ten inches below the glass, will be required for the purposes of training. The ground inside, and a border outside the front wall should be trenched eighteen inches deep, and filled with soft turfy loam, obtained from a sheep-common if possible. The subsoil must be dry, or be rendered so by drainage; and all water which falls on the lights may be carried off to a reservoir by a gutter in front. The aspect should be south by east.

Thus prepared, a good tree, the variety of which is not doubtful, (as the *Violet hâtive* or *Gallande* peach, and the *Elruge* nectarine,) is to be planted in the border, its stem let in through a central opening in the front wall, so that the tree may conform to the slope of the trellis.

The roots being carefully raised and distributed, covered with soft earth, insinuated into close contact with every fibre, then made firm by moderate pressure, and by pouring a copious stream of water on the covering soil, will progress without loss of time, and support a moderate crop of fruit in the following summer. This I proved in 1836, by having moved a young *bearing* peach in November 1835.

The operation of forcing, if so it can be called, will commence by putting on the lights in December; and in January applying a

strong lining, three feet wide, along the whole extent of the back wall. When the blossom buds swell, tarred deal boards should be put over the lights in the event of frost. Thus maintaining a temperature, without sun, of 50 to 56° by day, and admitting air freely during sun-shine, the growth of the wood and setting of the fruit will be secured. I speak from the experience of three years, confirmed by observing the progress of other trees, which have borne fine crops, almost without exception, for more than fifteen years.

A young tree must, of course, be educated for two or three seasons; but a tree ready for bearing may be moved without danger or loss of time, and ripe fruit, of the highest quality, can be gathered late in July, or early in August. Pruning is very simple; extra shoots are taken off as they appear, but no cutting out *in winter* is practised, nor till the fruit is set in spring; then, all useless wood is cut back, to a well-placed shoot to serve as a future bearer. Fertility takes the lead before *figure* in these peach-pits.

## PART II.

### OPERATIONS IN THE FRUIT DEPARTMENT.

89. The season for pruning in general approaches, as the blossom buds are now very discernible; therefore prune apricots, peaches, and nectarines, if the blossoms be much advanced: prune also apple and pear trees; vines, gooseberry and currant bushes. It has been remarked, that professional gardeners prune too much, and domestic gardeners too little. The entire removal of dead and cankered wood, and the regular distribution of the branches, are operations of real utility; but it is certain, that many trees have been forced to throw out useless wood, instead of fruit branches, and possibly have been much injured by habitual close pruning.

*Plant* fruit-trees of all descriptions; but choose open, *dry* weather.

*Remove* moss; and destroy insects on the bark of trees, by washing the stems with plain lime-wash, or with the one described in January, at No 49.

GRAFTING.—Apple and pear trees may be grafted towards the end of the month, though it is still full early. This is a scientific operation of great nicety, difficult to describe, and hardly to be understood from any mere description. More may be learned by attentively observing one operation performed by a skilful grafter, than by the perusal of twenty pages. However, as the success of grafting depends upon the knowledge of the physical structure of the tree, and of the due insertion of the scion into the stock, the subject will be fully noticed hereafter.

## MISCELLANEOUS.

90. Dig the shrubberies; sweep and roll gravel walks, and grass plats; trim the edges; cut up weeds, and remove them, and all litter to the compost heaps.

Sow in the flower borders, a few hardy annuals.

*Parterre* flowers for bedding out, should be sown *in heat*: *Verbena venosa*; *Rhodanthe Manglesii*: *Petunia* (varieties) *Clintonia*; *Thunbergia alata*, *et alba*; soak the seeds of the two latter in warm water.

*Transplant* and divide the hardier herbaceous plants.

*Hand-fork* (in mild, dry weather), the flower patches and borders: if carefully and neatly done, the surface will be made as smooth and level as after the finest raking, and with less risk of doing injury.

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91. The following trees, shrubs, and border plants will, in favourable seasons, be found in flower this month.

*Trees and Shrubs*.—Apricot, *Armeniaca vulgaris*; Peach, *Persica*; Mezereon, *Daphne Mezereum*; Bay, *Laurus nobilis*; *Laurus-Viburnum Tinus*.

*Perennial herbaceous Plants*.—Hepaticas, purple, blue, and white, *Anemone hepatica*; Lesser Periwinkle, *Vinca minor*; Polyanthus and lilac Primrose, *Primula veris*; Primrose, *Primula vulgaris*.

*Bulbous roots*.—Winter Hellebore, or Aconite, *Helleborus hyemalis*; Yellow Crocus, *Crocus vernus*; Snow-drop, *Galanthus nivalis*; Daffodil, *Narcissus pseudo-narcissus*.

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## THE NATURALIST'S CALENDAR.

## FEBRUARY.

FEBRUARY is usually a rainy month;—"February fill dyke;"—there are exceptions, however, of which the years 1827 and 1832 furnished decided examples: the first was brilliantly clear and frosty, for above three weeks of its course; and in the latter fogs prevailed, but scarcely a drop of rain fell. In general, the early part of the month partakes of the character of the latter end of the preceding one; and during the remainder, rain, frost, and thaw succeed each other alternately. The sun has gained so much power, that the thermometer indicates an increase of several degrees in temperature.

The average height of the barometer is about thirty inches.

Ditto ditto thermometer, about thirty-nine degrees.

*In the first Week.*—Blue titmouse (tom tit) *Parus cœruleus*, chirps; marsh titmouse, (*Parus palustris*,) utters its two sharp notes, resembling the sharpening of a saw; bees, (*Apis mellifera*,) appear; gnats, (*Culex pipiens*,) float in the sun-beams; and insects hover about sunny banks; moles, (*Talpæ*,) throw up their heaps; brown owl, (*Strix ulula*,) whoops; and song thrush, or throstle, (*Turdus musicus*,) sings.

*Second Week.*—Turkey-cock, (*Meleagris gallo-pavo*,) gobbles and struts; yellow-hammer, (*Emberiza flava*,) sings; sulphur butterfly, (*Papilio rhamni*,) appears; goose (*Anas anser*,) lays; sheep (*Ovis aries*,) drop their lambs; blackbird, (*Turdus merula*,) sings.

*Third Week.*—Rooks, (*Corvus frugilegus*,) pair; raven, (*Corvus corax*,) builds; partridges, (*Tetrao cinerea*,) pair; house sparrows, (*Fringilla domestica*,) chirp and begin to build; chaffinch, (*Fringilla cœlebs*,) sings; green woodpecker, (*Picus viridis*,) clamours and laughs.

*Fourth Week.*—Viper, (*Coluber borus*,) appears; goldfinch, (*Fringilla carduelis*,) sings; pheasant, (*Phasianus gallus*,) sets; wood and field-larks, (*Alauda, arborea et arvensis*,) sing; and the curlew, (*Charadreus Oedionemus*,) utters its quick, short note.

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## MARCH.



## SECTION I.

## SCIENCE OF GARDENING.

## PART I.

## WATER.

*Inquiry into the Nature of Water.*

WHAT is water? A more important question in natural history, the solution of which involves more stupendous labour, can scarcely be proposed: it is an inquiry into the nature of that fluid which, under the familiar term *water*, comprises seas, lakes, rivers, springs; in a word, all that constitutes the aqueous portions of the globe. To this important question, how-  
ever, no answer would, within little more than half a century  
past, have been unhesitatingly returned: it would have been  
said, that “water is a simple element,” for such it had been  
long considered; “one of the four elements, entering into the  
composition of most bodies; a fluid menstruum, a ready solvent  
of many substances, but itself incapable of decomposition. Yet its  
duration has been going on from the remotest period of time,  
and has been of and unobserved. This is a fact, as Lavoisier remarks,  
which proves that in chemistry, as well as in philosophy, “it is  
difficult to overcome prejudices imbibed in early education,  
and to search for truth in any other road than the one we have  
been accustomed to follow.”

An inquiry into the true nature of water includes matter of  
great interest and curiosity; and by comparing a variety of  
theories, which I select from writers of acknowledged authority,  
the reader will be enabled to form a tolerably correct idea of the  
various credited theories. To these quotations will be added such  
remarks as shall tend to explain and apply the electrical theory  
given at Number 66, and to demonstrate the certainty and  
the extent of electric agency, in the induction of the striking  
sparks which accompany the decomposition and formation of

It may be fairly presumed, that the most valuable discoveries in  
natural history are originated either in conjecture, or in what is termed

chance. By submitting to the test of experimental scrutiny conjectures on subjects not absolutely capable of being confirmed by actual experiment, important discoveries may be effected and philosophical truths established: thus the mind of Newton, reasoning from analogy, suggested the combustible nature of the diamond; and thus an observant eye, viewing *one* particular phenomenon, may be led to determine the precise nature or cause of some other phenomena connected therewith, which had puzzled the most renowned philosophers of the age. An almost insurmountable obstacle to the advance of philosophical inquiry has heretofore been raised by that implicit deference which is usually paid to the authority of great names. Thus the *phlogistic* theory of Stahl maintained its ascendancy for more than fifty years, although abounding with the most palpable contradictions; for it was received and supported by the most eminent chemists of Europe. But science was then in the hands of the few *learned*; it is now spreading through the ranks of the *inquiring* many; and these, it is to be hoped, while they respect the authority of great names, will never henceforward take that for granted, which can by any means be submitted to the scrutiny of scientific experiment. It is to such scrutiny,—liberal, because scientific,—that I submit any conjectures which I may advance in opposition to received opinions and accredited theories.

93. *Compound nature of water.*—About the year 1781, the discovery of the decomposable nature of water was detailed in the *Memoires* of the French Academy: who the discoverer really was, has been contested, and it is still doubtful. Dr. Priestley, there is reason to believe, first effected the decomposition of water; but the appreciation of the real and determinate nature of the discovery is usually ascribed to Mr. Cavendish.

Little more than half a century has elapsed since the idea of the simple, elementary nature of water has been abandoned. Subsequently, however, to the actual discovery, innumerable experiments, both analytical and synthetical, have proved to a demonstration the compound nature of water, and have appeared to determine, pretty accurately, the proportions of its constituents: for it has been found, that if two parts of *hydrogen gas* be ignited and burnt, with due precaution, in a vessel containing one part of *oxygen gas*, both calculated by measure, and not by weight, the product will be pure water. To effect the union of the two gases, it is usual either to pass an electric spark through them, or to kindle the hydrogen first by actual fire, and then to introduce the jet pipe from which it issues, into a globular glass vessel, containing the oxygen gas; but considerable caution is required, as the experiments are sometimes

productive of the most violent explosions. In fact, they should not be attempted by inexperienced persons, as dangerous consequences might ensue.

94. *Composition of water.*—1st. According to Lavoisier, (*Elem. c. 8. exp. 3.*) it appears, that by passing the steam of boiling water through a glass tube, heated to redness in a furnace, and containing 274 grains of soft iron turnings, 100 grains of water having been decomposed, 85 grains of oxygen had combined with the iron, so as to convert it to the state of black oxide; and 15 grains of a peculiar inflammable gas were disengaged. “From all this,” says he, “it clearly follows, that water is composed of oxygen, combined with the base of inflammable gas, in the proportion of 85 parts by *weight* of the former, to 15 parts of the latter.” Such are the words of the father of modern chemistry.

2nd. According to Parkes, (*Rud. No. 108.*) “water is composed of 88 parts by weight of oxygen, and 12 of hydrogen, in every 100 parts of the fluid.” “Water is found to be a compound of 1 part hydrogen, and  $7\frac{1}{2}$  parts oxygen, by *weight*; this will give in the 100 parts the proportions of nearly  $11\frac{1}{3}$  of hydrogen, and  $88\frac{1}{3}$  of oxygen. If the gases are estimated by their measure, water will be found to be composed of two measures of hydrogen, and one of oxygen.” (*Ibid note.*)

The same author, however, in his Chemical Essays, (*Water*, vol. ii. p. 256.) gives other proportions of the constituents of this fluid; and therein he accords with Lavoisier. “Water is composed of oxygen and hydrogen, in the proportions of 85 parts by weight of the former, and 15 of the latter. These are what are deemed the usual proportions, but they cannot be considered as absolutely and undeniably correct; because the quantity of aqueous vapour which the gases usually contain, renders it difficult, if not impossible, to produce an accurate estimate. Some experiments of Ritter seem to prove, that *frozen* water contains a less proportion of oxygen.” By the “atomic theory,” or rule of definite equivalents, hydrogen being assumed the standard unit, or 1, and oxygen being eight times heavier or 8, 9 is the atomic weight of water; then, as  $9 : 8 :: 100$  to 88.888; the hydrogen, therefore, will be represented by 11.111, in every 100 parts.

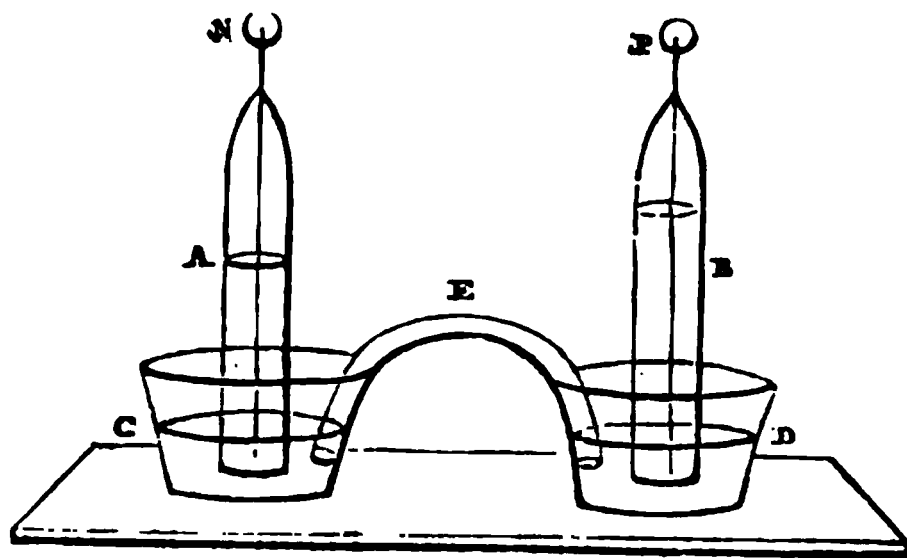
3rd. “If the metal called potassium, be exposed in a glass tube to a small quantity of water, a violent action will ensue; an elastic fluid will be disengaged, which will be found to be hydrogen; and the same effects will be produced upon the potassium as if it had absorbed a small quantity of oxygen; and the hydrogen disengaged, and the oxygen added to potassium, are in weight

as 2 to 15: and if 2 in volume of hydrogene, and 1 in volume of oxygene, which have the weights of 2 and 15, be introduced into a close vessel, and an electric spark passed through them, they will inflame and condense into 17 parts of water."—(*Davy's Agric. Chem. Lect. v.*, p. 191.)

It may be here proper to observe, that some have suggested the probability of earthquakes having been occasioned by the decomposition of water through the agency of metals, particularly those of *potassium* and *sodium*, both of which were discovered by Sir Humphry Davy. The eruption of Vesuvius, in 1822, was accompanied by a discharge of chloride of sodium, (*common salt*.) Rock-salt and salt-mines may possibly, therefore, have been produced by the decomposition of water in former ages, through the agency of the metal sodium.

85. *Water may be decomposed by the electric spark*, but with some difficulty, unless by an apparatus of a peculiar construction; but with the voltaic (*i. e.* galvanic) apparatus, the process of decomposition may be effected with the utmost facility. One of the most luminous experiments with the voltaic electricity, will now be described as concisely as possible; it is very frequently exhibited by public lecturers, and the figure annexed is taken from the first volume of the *Mechanic's Register*, p. 379.

Fig. 1.



Let two glass tubes, A B (fig. 1), be filled with pure water, and then inverted into the two cups C D, each containing water in sufficient quantity to admit of the complete immersion of the ends of the tubes, so as to keep them full of water. N P are platinum wires, each furnished with a ring at the upper extremity; they each pass through a cork at the top of the tube, and are carefully secured with cement, so as to render the junction perfectly air tight. The two cups are connected by means of the bent tube E, which is first filled with water, or a coloured fluid, and then inserted, one end in each cup, the two orifices being secured by the fingers, till immersed, when the

tube will remain full. The electric circuit is to be completed by connecting the ring *p* with the positive (or zinc) end of a voltaic battery, and the ring *n* with the negative (or copper) end, by means of two wires, one proceeding from each end; and when so completed, the decomposition of water is gradually effected: the tube *a* receives *hydrogen gas*, and the tube *b* *oxygen gas*, the former in the proportion of two to one of the latter. This experiment was performed by that scientific philanthropist, Dr. Birkbeck, before the members of the Mechanic's Institution, on the 30th March, 1825.

Voltaic troughs or batteries are sold by philosophical instrument makers; they are usually composed of alternate plates of zinc and copper, on the principle of the former metal being positive in its electrical relation to the latter. These plates are united, and then are placed in a mahogany case, and between each pair there is a cell or space; these cells are to be filled with a very dilute acid solution, usually composed of nitric and sulphuric, or muriatic acids, in a considerable proportion of water. The grand battery of the Royal Institution consisted of 2000 double plates, constituting a total surface of 128,000 square inches; the cells were filled with a diluted acid, composed of water, in the proportion of 60 parts, to one part each, of sulphuric and nitric acid. The effects produced, and which are described in Sir Humphry Davy's *Elements of Chemical Philosophy*, may be conceived, when it is stated, that "When any substance was introduced into this arch," (*i.e.*, the fire produced by the two opposite poles of the two wires,) "it became instantly ignited; platinum melted as readily in it as wax in the flame of a common candle; quartz, the sapphire, magnesia, lime, all entered into fusion; fragments of diamond, and points of charcoal and plumbago rapidly disappeared, and seemed to evaporate in it, even when the connexion was made in a receiver, exhausted by the air-pump: but there was no evidence of their having previously undergone fusion."

An improvement in Voltaic troughs has been announced by Doctor Faraday, whereby increased action is made compatible with a great reduction in the dimensions of the instrument. See *Experimental Researches on Electricity*, 10th series, from the *Philosophical Transactions*, Part ii. for 1835.

But the most important discovery in electro-chemical science, appears to be that of the "Absolute quantity of *electricity associated with the particles or atoms of matter*," by Dr. Faraday: the experiments described in the sixth series of his *Researches*, appear to be conclusive. Paragraph 853 will convey some idea of the stupendous volume of the ethereal fluid which enters into the composition of *water*; or is required to develop its gases. "Now it is wonderful

to observe how small a quantity of a compound body is decomposed by a certain portion of electricity. Let us, for instance, consider this, and a few points in relation to water. *One grain of water acidulated to facilitate conduction, will require an electric current to be continued for three minutes, and three quarters of time, to effect its decomposition, which current must be powerful enough to retain a platina wire,  $\frac{1}{16}$  of an inch in thickness, red-hot, in the air, during the whole time; and if interrupted any where by charcoal points, will produce a very brilliant and constant star of light. If attention be paid to the instantaneous discharge of electricity of tension, as illustrated in the beautiful experiments of Mr. Wheatstone, (Phil. Mag., 1833, p. 204,) and to what I have said elsewhere on the relation of common and voltaic electricity, (371, 375,) it will not be too much to say, that this necessary quantity of electricity is equal to a very powerful flash of lightning. Yet we have it under perfect command; can evolve, direct, and employ it at pleasure; and when it has performed its full work of electrolyzation, it has only separated the elements of a single grain of water."*

Again, in par. 854-5, we find that the relation between the conduction of electricity, and the decomposition of water is so close, that *one cannot take place without the other*: also, that for a given, definite quantity of electricity passed, an equally definite and constant quantity of water, or other matter is decomposed; and that the agent, which is electricity, *is simply employed in overcoming electrical powers in the body subjected to its action*; On these grounds, "it seems a probable, and almost a natural consequence that, the body which passes is the *equivalent* of, and therefore equal to, that of the particles separated; that if the *electrical power which holds the elements of a grain of water in combination, or which makes a grain of oxygen and hydrogen in the right proportions, unite into water when they are made to combine, could be thrown into the condition of a current, it would exactly equal the current required for the separation of that grain of water into its elements again.*" *New Researches*, Sixth Series, pp. 116, 117.

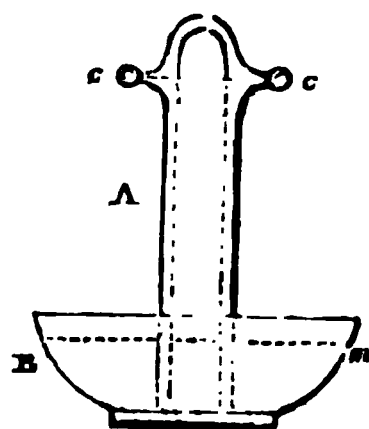
This view of the subject gives an almost overwhelming idea of the extraordinary quantity or degree of electric power which naturally belongs to the particles of matter; but it is not inconsistent in the slightest degree with the facts which can be brought to bear on this point.

I view the experiments of Dr. Faraday with astonishment, and hesitate to propose a doubt concerning his inference that the quantity of *decomposing electricity which passes* is the equivalent of that which *retains the elements oxygen and hydrogen together, in the form of*

*fluid water.* But it occurs to me, that if water contains a definite volume of the ethereal fire, called electricity, in a state of neutrality and repose, this neutrality is disturbed by the voltaic current, and thus the two elements are separated in the state of gas. Now, is it not reasonable to infer, that the increased volume which the gases occupy, is produced by the vast quantity of electricity with which they combine, and by which they are retained in their aerial form. The electricity of the fluid water *may pass off*; but *that* conducted from the *two poles* of the battery, appears to be associated with the elements, electrolyzing one with the electricity of hydrogen, and the other with the electricity of oxygen. Let us consider the instruments we find employed—a powerful current—two *active poles*—(*Electrodes*)—a compound body, (water,) as the *electrolyte*, decomposable into *two* aerial gases, of very different specific gravities, capable of re-uniting with a loud explosion, and the extrication of a brilliant flash of light! Do we not perceive cause to admit the existence, and antagonist energy of two *powers*; and are we remote from the truth, when we hazard the conjecture that in *Electricity* and *Magnetism*, we discover these two *powers*?

96. *Water may be produced synthetically—i. e.* by the union of the gases. 1st, By firing them with the electric spark in the detonating tube, (fig. 2,) placed securely in a mercurial pneumatic trough, or in a basin containing mercury. Thus, *A* is a very strong glass tube, with two gold or platinum wires, *cc*, fitted into the two projections of the tube; the extremities of these wires within the tube, are about one-eighth of an inch apart. *B* is a basin containing the mercury *m*. The tube being first filled with mercury, to displace the air, is to be introduced into the basin, and then, a cubic inch of a mixture of the two gases, in the proportion of two parts of hydrogen to one part of oxygen, is to be passed into the tube; hold the tube firmly, and explode the gases by the electric spark: they will disappear, and by frequent repetitions of the process, a sensible portion of water will be obtained. The experiment may be varied, by filling the tube with pure water, the basin containing water also; then decompose the water by the voltaic electricity, and when the gases have been formed in sufficient quantity to displace all the water *above* the points of the wires, the first spark that passes through the gaseous volume will explode it, and the water will again rise and fill the tube. Thus, the same experiment will exemplify the *analysis*, or decomposition of water, and the *synthesis*, or re-formation of the fluid, from its own gaseous products.

Fig. 2.



2nd. *By combustion*; for as water, or its elements, exist in all vegetable productions, the combustion of such substances, and of all other things with hydro-carbonous bases, (*i. e.*, such as are composed of hydrogen and carbon,) always produces water, or watery vapours. Thus, the combustion of *alcohol*, (vinous spirit,) and of the gas called *carburetted hydrogen*, which is employed for lighting the streets, always yields a very large quantity of water, for their hydrogen unites to the oxygen of the atmosphere, and water is the product.

*By pressure.* In a memoir read to the National Institute of France, M. Biot announced the fact that a mixture of hydrogen and oxygen gases, may be made to explode by mechanical compression. This mixture was introduced into a strong metallic syringe, furnished with a glass bottom, and a sudden stroke was given to the piston. An extremely brilliant light appeared, accompanied with a loud detonation, and the glass bottom was forcibly driven out. This result affords proof presumptive, that the gaseous condition of the two elements is maintained by the volume of ethereal fire which is combined with, or interposed between their ultimate atomic particles!

97. They who are desirous to obtain farther information concerning the great variety of processes by which water may be produced, or decomposed, are referred to Lavoisier's *Elements*, Henry's *Epitome*, Parkes's *Rudiments of Chemistry*, and Faraday's *New Researches*. These works contain also, references to excellent plates, illustrative of the apparatus employed. Enough has been said here, to prove the accuracy of the generally received opinion concerning the compound and decomposable nature of water; and with one quotation from the sixth chapter of Dr. Henry's *Epitome*, I shall conclude the first part of this section. After stating that water is formed by the union of the two gases, he adds, "the water produced, is not, however, to be considered as a compound of the two gases, but only of their *bases*; for the *light* and *caloric* which constituted the gases, escape, in considerable part, during the combustion\*." Every gas, it must be remembered, has at least two ingredients; the one, gravitating matter, which, if separate, would probably exist in a solid or liquid form; the other, an extremely subtile fluid, termed *caloric*, (and perhaps, light,) is a common ingredient

\* The reader should, I conceive, endeavour to get rid of the erroneous impressions produced by the use of the term *caloric*. I therefore would urge him, wherever he may meet with it, to substitute that of *electricity*, or of *elementary fire*; the terms are synonymous, expressive of a *real active principle*, which as far as it is capable of being understood, will account for all the phenomena of *light* and *heat*.

both of hydrogen and oxygen gases: but the two differ, in having different bases. The basis of the one is called hydrogen, and of the other, oxygen; and *water*, may, therefore, be affirmed to be a *compound of hydrogen and oxygen*."

## PART II.

### INVESTIGATION OF THE CONSTITUENTS OF WATER.

98. *Of the nature of hydrogen.* The term hydrogen was given by Lavoisier, and other French chemists, to that base or radical, which, when in combination with oxygen, constitutes water. Lavoisier thus accounts for the origin of the term: water contains another element as its constituent base or radical; and for this proper principle or element we must find an appropriate term. None that we could think of seemed better adapted than the word *hydrogen*, which signifies the *generative principle of water*, from  $\upsilon\delta\omega\rho$ , *aqua*, and  $\gamma\epsilon\iota\nu\omicron\mu\alpha\iota$ , *gignor*. We call the combination of this element with caloric, *hydrogen gas*; and the term *hydrogen* expresses the base of that base, or the radical of water. "Hydrogen in the state of gas, dissolves carbon, sulphur, phosphorus, and several metals: we distinguish these combinations, by the terms, *carbonated hydrogen gas*, *sulphurated hydrogen gas*, and *phosphorated hydrogen gas*." The latter gas is remarkable for the property of taking fire spontaneously, upon getting into contact with atmospheric air, or what is better, with oxygen gas."—*Elem.* edit. 1802. Vol. i., p. 141-165.

"Hydrogen," says Parkes, "is the base of the gas which was formerly called inflammable air; and is, when in the aëriform state, the lightest of all ponderable things." "Hydrogen gas is only one-fourteenth of the weight of atmospheric air, and occupies a space 1500 times greater than it possessed in its aqueous combination. Hydrogen is continually emanating from vegetable and animal matters during their decay, and is a certain consequence of their putrefaction; it is also evolved from various mines, volcanoes, and other natural sources. The ignis-fatuus, or *will-o'th'-wisp*, originates from decayed vegetables, and the decomposition of *pyritic coals*\*: it consists generally of hydrogen combined with carbon, and perhaps occasionally with phosphorus or sulphur."—(*Rudiments*, No. 115, 119, 220.)

*Hydrogen gas* can never be obtained pure, but by the decomposition of water; for experiments, it is usually procured by pouring sulphuric acid, formerly called oil of vitriol, diluted with 5 or 6 times

\* Pyritic, that is an union of *sulphur* with a metal.

of water, on iron filings, or granulated zinc, and the gas so produced possesses the following properties.

(a) It is *inflammable* in atmospheric air or oxygen gas; that is, it enters into electro-chemical union with a body possessing opposite electric qualities, or in other words hydrogen being, as it is termed, *positive* to oxygen, which latter is *negative* to hydrogen, the two gases tend to form an union either from the attractive influences of their two electricities, or, it may be from their peculiar electrical condition.

(b) It will not burn unless it be in contact with one or other of those substances which are termed *supporters* of combustion: thus an ignited jet of hydrogen gas will be instantly extinguished if plunged into a vessel containing the *same gas*, provided it be absolutely pure, and free from the slightest admixture of common air or oxygen gas.

(c) It has an unpleasant smell, at least when it has been procured by the agency of metals in the decomposition of water.

We may collect, from all that has been advanced, that hydrogen gas is considered by chemists, as an elastic fluid, consisting of a peculiar base, in combination with a large portion of *caloric*, or the matter of heat; but which caloric is *latent*, (that is, in a state wherein it makes no sensible addition to the heat of the body with which it is combined); that its peculiar levity is owing to its capacity for caloric, which "separates the particles, and gives the whole a gaseous form," causing these particles to repel one another by the power of repulsion, which is known to exist in the particles of caloric among themselves.

99. The *base of hydrogen gas* has never been detected in a separate state; nor does it appear that chemists have in any instance, been able to determine what its nature really is. Some have supposed, that it may be a *metal*, and I am inclined to believe that Sir Humphry Davy once expressed an opinion to that effect. Be this as it may, hydrogen gas, as has been seen in Dr. Birkbeck's experiment, 85, separates at the negative pole; and from having observed that *alkalies* attached themselves to the same pole, Sir Humphry Davy was led to perform those experiments which terminated in the discovery of the metallic nature of potass, soda, and other alkaline substances. To me, *hydrogen gas* appears to be a peculiar *base* in electro-chemical union, with a very large proportion of *electricity* of a specific kind, and which might be distinctively styled the *electricity of hydrogen*. This gas, as has been observed, can be procured in a pure state, solely from water; and its *base* has never been detected in a separate state: hence, I would suggest, that it exists, and is

only to be found in *water*; which fluid may then be philosophically considered as the primeval, and sole natural source of *hydrogen* throughout the creation, be its subsequent combinations as numerous and multiform as they may. If water, then, be the grand and only source of hydrogen, as a *base*, it may be admitted that, the first sun-beam, by its electrizing influence, developed the first atom of hydrogen gas, both within, and above the surface of the earth,—in a state of *simple purity*, as well as in all the varieties of those combinations, that may be termed *oxides* of *hydrogen*: among which, *atmospheric air* may probably be considered as by far the most important. I do not assert that hydrogen gas cannot have a metallic base; but I think it much more probable,—taking into consideration, the universal diffusion of water, and the peculiar metallic composition of meteoric stones,—that the *metals* owe their origin to *hydrogen*, than that the *base* of hydrogen is to be sought for in metals. This conjecture will acquire probability from the circumstance that potass, and other alkaline substances are detected in the ashes of several plants; and indeed, we may be led to ask, from what portion of the vegetable substance, *can* the process of burning form and develop the *bases* of those metallic oxides that we term alkalies, unless it be from the hydrogen which it contains? The inquiry is one of a peculiar interest, and well worthy of the attention of the philosophic chemist.

100. *The decomposition of ammoniacal gas* tends to confirm the theory of the electrization of hydrogen. That gas is found by analysis to consist of three definite proportions of hydrogen gas, and one of the gas termed *azote*, or nitrogen. If a cubic inch of ammoniacal gas be conveyed into the detonating tube, (fig. 2, No. 96,) standing over mercury, and a succession of from 150 to 200 electric shocks be passed through it, the volume of gas will be much enlarged by the disturbance of the chemical union of the two constituents. It will be found also, that the quality, as well as the volume of the gas, has undergone a change, for it is no longer absorbable by water; whereas, ammoniacal gas is so, to a very great extent. Under these circumstances, if about one-third of the bulk of very pure oxygen gas be admitted, and another electric shock be passed through the wires, a loud detonation will ensue, the volume will be reduced, traces of water will be perceived, and the remaining gas will be found to consist chiefly of *azote*. *Electric agency* has effected these changes; and thus we have decisive evidence, that the chemical phenomena of decomposition, and the formation of a new compound, have been induced, and effected by that agency. If this be

admitted, it must follow as a necessary consequence, that all chemical action depends chiefly, if not altogether, upon electric agency.

101. *Of the nature of oxygen.*—Oxygen, according to Parke, “is the basis of vital air, as well as one of the constituent parts of water; it is the chief support of life and heat: and performs an important part in most of the changes which take place in the mineral, vegetable, and animal kingdoms.”—(*Rud.* 114.)

“We have given,” says Lavoisier, “to the *base* of the respirable portion of atmospheric air, the name of *oxygen*, from *οξύς*, acidum, and *γεννῶμαι*, gignor, because one of the most general properties of this base is to form acids, by combining with many different substances. The union of this base with caloric, which is the same with what was formerly named *pure*, or *vital*, or *highly respirable air*, we now call *oxygen gas*.

Mr. Hume, of Long-acre, printed a little pamphlet, from a paper which had been addressed by him to Mr. Tilloch, in July 1808, and which appeared in the *Philosophical Magazine*, vol. xxx. Its subject was, “The Identity of Silex and Oxygen:” this pamphlet is now before me, and from it I shall extract some passages, which may tend to excite much interest and reflection. I have been obliged somewhat to abbreviate, but the extracts are absolutely faithful; and whenever the phraseology is altered, the meaning remains unchanged. At pages 5, 6, and 7, Mr. Hume says, “All organized bodies either contain silex, or, what I shall consider as a modification, oxygen. In a geological view of this subject, where can we turn our eyes, or employ our thoughts, without meeting this grand and multifarious cement,—this bond of aggregation, that fixes the solidity of all tangible nature? The very outlines of our planet are traced out with it; and all primitive matter, from the most stupendous mountain, or rugged precipice, to the deepest cavern, even to the centre of gravitation, we are warranted to say, is replete with silex.

“Where, then, ought silex to be placed, in the arrangement of simple elements? Were I asked for an answer to such a question, I would say, that seeing nothing to which it has the slightest resemblance in its effects, but oxygen gas, of which I conceive it to be the true base, here I would not only assign its proper rank, but give it also a precedence to all other elementary matters that had resisted decomposition. It is hardly necessary for me now to add, that I do not consider oxygen in the state of *gas*, to be a simple body; for whatever is susceptible of spontaneous change, should always be deemed a compound of at least two elementary substances.” Mr. Hume then alludes to the liability of oxygen gas to undergo this *spontaneous change*, on the authority of Messrs. Allen and Pepys,

who found that it “will happen, though the gas be of the purest kind,—that obtained from oxy-muriate of potash,—and even when secured in glass vessels with glass-stoppers.”

Having assumed *silex* and the *base* of oxygen gas to be synonymous, and simple bodies, Mr. Hume defines what he means by the word *silex*,—namely, “the very *pure* part of rock-crystal, and that which constitutes by far the greatest portion of all sand, flint, gravel, and other well-described rocks, stones, and minerals: a substance common in every spot of the globe, in every zone, and in every climate; and an article so obvious and familiar to the meanest capacity, that any further description would be superfluous. In rock-crystal—in quartz, and in hot springs, *silex* is nearly in its pure and primitive state of perfection.”

In his researches for oxygen, Mr. Hume, (pages 7 and 8,) says, “Let us consider this our sublunary world under its three grand divisions. The first is the atmosphere,—the aëriform division of nature. Here, it is allowed, the principal element is oxygen; but it is now in the gaseous state; that is, it is saturated with caloric. I have said the *principal* element, because it is the most important of all others: it is the matrix of fire; it is the pabulum of life; in short, such is its consequence and value to the very being of all organized matters, whether in the animal, vegetable, or mineral kingdom, that surely some more appropriate name might have been devised, than that which it now bears.” Mr. Hume adds, that by modifying, or in some measure reversing the *phlogistic* theory, both the theory, “and the word phlogiston\*, even in the doctrine of the present day, would more aptly suit our comprehension, than that of *oxygen*. The second grand division is that of the ocean, sea or water. Here we again recognise our oxygen, not only as the principal ingredient in magnitude, being about four-fifths of the whole; but in all respects, claiming our first attention. In this water, the oxygen is

\* *Phlogiston*:—*fired fire*, or the inflammable principle of Stahl. On this name, when considered as a substitute for *oxygen*, it may not be amiss to remark, that Mr. Edmund Hart, of Nottingham, in one of his letters on the fallacy of the doctrine of *latent heat*, proposes to make use of two greek words, “*pur*, fire, and *gen*, a generator,” to form the word “*purugen*,” whereby, to define that simple elementary fire, which pervades all nature; and which philosophers have mistaken for latent heat.

As the word *oxygen* cannot be philosophically maintained, might not the term proposed by Mr. Hart, substituting the English letter y for the u, become a tolerably expressive term for the substance now called oxygen? As a prime supporter of combustion, it would be appropriate, and if altered to *pyrogen*, the sound would not be offensive to the ear accustomed to that of oxygen: the greek *v*, (*upsilon*), being changed to y in both, and in many similar words.

further concentrated, having lost a part of the caloric which it possessed in the gaseous form; and thus, by an abstraction of more of its caloric, it must approach nearer to a state of solidity." As respects the third division—the *solid*, or real terrestrial portion of this material world, Mr. Hume thinks his theory of the identity of silex and oxygen is supported by a mass of evidence, and that every spot in the globe teems with examples. "There is not a rock, from the most huge and congregated lumps of matter, to the most trifling protuberance; nor is there a morsel of any mineral compound, from the brilliant gem, to the most unfruitful and degraded soil, in which, if there be an earth, a metal, an alkali, or any other salifiable or oxidable element, the saturation is not always due either to the silex alone, or to some acid, and consequently to something containing oxygen." (page 9.) Mr. Hume argues the transmutation of silex into *lime*; and supports his arguments by analogy, and by reference to authorities: thus, at page 23,—“From the experiments of M. Volta we are informed, that all the waters of Verona contain silex in the state of carbonate of lime, or *chalk*, and, agreeably to this philosopher’s opinion, this substance is held in solution, by means of oxygen:” and at page 33 he refers to the *Ann. de Chimie*, for a variety of experiments performed by M. Vauquelin, with a view to ascertain the origin of the formation of *lime* in the body of the common hen, and from which the egg-shell can be derived: he quotes a passage from M. Vauquelin, which concludes thus, “if new efforts, often repeated, should be conformable to these, we must be compelled to acknowledge from them, that, during the digestion of the hen, *silex is converted into lime*.”

The remarkable similarity in the effects of oxygen and silex on the metals, is noticed at page 19; particularly that process called *nitrication*, “which is, in every meaning of the word, a complete saturation and oxidizement. By means of these, particularly the silex, all the metals, perhaps, with no exceptions, from being the most opaque bodies in the universe, may be rendered quite pellucid, affording a variety of the most charming tints (page 20); even the precious stones, &c., seem to derive their intrinsic value, beauty, and other excellencies, entirely from the power of silex on the metals.” The power that it “exercises over potash, soda, and a variety of other substances, which enter into the composition of glass, is a notorious instance of its neutralizing efficacy, for no acid more completely obtunds the acrimony of alkaline bodies, and disarms them of their corrosive character.” At page 25, Mr. Hume appears to indulge the idea that *silex*, and consequently oxygen, may be allied to electricity. “It has been noticed by several authors,

that the peculiar smell which is evolved when flint, or any siliceous stone gives out sparks of fire, is precisely the same to our senses as that which succeeds electrical excitation, or the strong effects of lightning from the atmosphere." "One remark may be tolerated, and not deemed an intrusion on the present occasion; it is this, that this singular identity of smell, stamps silex with such a degree of consequence, as to assimilate it in this quality, at least, with one of the most important objects of nature, the electric fluid of the atmosphere."

I have quoted somewhat at large, and as some may think irrelevantly; but I conceive the subject to be one of deep interest, and that it is treated in a masterly and very argumentative manner. The inquiry into the real nature of the *base* of oxygen gas is also pending, and Mr. Hume's treatise is on that subject: he, as we have seen, thinks it to be *silex*, or flint; other authors give no opinion on the subject; but all agree in considering oxygen gas as a peculiar *base*, saturated with *caloric*.

I think it will not be hazarding too much, to conjecture that, *oxygen gas*, as well as hydrogen gas, originates solely in the decomposition of water, in which fluid, its *true base* is to be found co-existent with the *base* of hydrogen gas; that they have no other, nor more remote origin; and hence, that all the phenomena, which depend upon the agencies of these two gases may be traced *primarily* to the decomposition of water, effected by the electrizing principle of the sun's rays, a principle which has been in active operation from a period coeval with that of the sun's existence. *Oxygen and hydrogen gases*, may then be defined, as two gaseous elastic fluids, derived from water by the operation of solar induction; by which operation, they each receive electricity of a specific nature or modification, the one contrary to that of the other; by the repulsive agency of which specific electricities, each is retained in the gaseous state, till, by the action of some more powerful agency, these gases are induced, either to enter into combination one with the other, or to form electro-chemical affinities with other bodies, from which result a vast variety of products, gaseous, fluid, or solid, according to the nature of the several constituents; all of which are of essential importance in the economy of nature.

To define in few words what I mean by *natural electricity*. I consider it a modification of the sun's light. LIGHT—that is, the solar ray—is poured upon the surface of the globe: *extinguished* it cannot be,—therefore, it must be absorbed. It may indeed, undergo transmutations; but whether it do, or do not, the solar light is the source and origin of that *elementary fire* which pervades all matter,

and is the grand vivifying principle. While undisturbed, it remains neutral, quiescent, and, as it were, masked; but when excited by chemical action, by friction, or by percussion, it becomes revealed, or is rendered manifest by its effects. This elementary fire, when revealed in the grander phenomena, is natural electricity. The ingenuity of man has enabled him to call it into activity by his machinery; and then it may be styled *artificial* electricity; but the prime motor is one and the same.

102. *Laws of chemical attraction and repulsion.*—In the present imperfect state of our knowledge, chemical science being assuredly but in its infancy, we are scarcely authorized to make use of the terms *law* or *axiom*: however, as some *general principles* may be of real utility to the student, as tending to fix or give a direction to his ideas, I shall comprise under three heads, those principles, which appear to me as philosophical deductions, either from ascertained facts, or from sound, analogical reasoning. For the first two laws, or principles, I am wholly indebted to the high authority of Sir Humphry Davy: the third is dependant upon the two former; but it is more general and comprehensive in the views which it embraces.

(a.) All bodies which have a chemical affinity for each other are in *opposite* states of *electricity*; and chemical affinity depends so much upon electricity, that these natural affinities may be modified or destroyed, by inducing a change in the electrical states, by artificial means.

(b.) Those substances or bodies, which are incapable of chemical combination, are uniformly in the *same* electrical states: hence, they *repel*, but cannot attract each other.

(c.) Since bodies which *attract* one another are possessed of *different* electricities, and those which *repel* one another are possessed of the *same* electricities,—phenomena which are in exact conformity with those of artificial electricity,—it follows that all bodies which attract or repel one another are electrified bodies. When bodies possessing opposite qualities, such as those of *acid* and *alkali*, enter into an electro-chemical union, they do it by the attractive or disposing influence of their two electricities; and in this act of union, the two chemical bodies, as well as the two disposing electricities, neutralize each other, and lose their distinctive qualities. And as the union has been induced, and effected by electric attraction, so it is *retained* by the quiescent attraction of the two electricities, till it is disturbed by a more powerful agency, which may induce a change in the first compound, and give its constituents a tendency to enter into new arrangements. This law will bear upon the whole

range of chemical affinities, and hold good in every species of chemical attraction under whatever name or designation it may be known; whether it be that of "simple, compound, disposing, quiescent, or divellent" attraction.

When it is considered, that many substances become electrified by passing from a liquid to a solid state, that electricity is developed by the conversion of water into steam and vapour, by the simple contact of metals, by the sudden rending asunder of pieces of dry wood, (a fact, by the way, that throws light upon the subject of the attraction of cohesion,) by the mere projection of powders upon the cap of an electroscope, and by almost every act of friction, pressure, or percussion, there can remain but little doubt of the universal distribution of this subtile fluid. When, moreover, it is acknowledged by electricians, "that there is every reason to presume that electricity is essentially concerned in the processes that are carried on in the living system, both of animals and vegetables" (every hair, prickle, thorn, or pointed projection of the vegetable body being a most perfect agent of conduction); "when in the animal economy more particularly, the operation of this agent is indicated in the processes of secretion, in the action of the muscles and nerves, and probably, in all the vital functions:" when it begins to be admitted, "that there can be question that electricity is occasionally, if not universally elicited during chemical action," (*Treatise*, No. 116,) it surely may be allowed me to append the third law, to the two which precede it; and moreover, without incurring a charge of presumption, to assume as a philosophical truth, one which will, in some future day, become an *axiom* in chemistry, "*that, every action of chemical affinity is induced and maintained, by the agency of electrical attraction.*"

### PART III.

#### WATER CONSIDERED AS ONE OF THE GRAND NATURAL AGENTS.

103. *Decomposition of water by natural agencies.*—There are many very striking phenomena, which attend the natural decomposition of this wonderful fluid: I shall endeavour to class and describe them under three separate heads.

(a.) Includes those which are occasioned by solar electric agency, inducing decomposition in the waters superficially deposited on the earth's surface: these, of course, include seas, lakes, rivers, &c. The phenomena which result from this agency, may be chiefly

referred to the atmosphere; the consideration of them, therefore, properly belongs to the "Section on the *atmosphere*," in the succeeding month.

(b.) Includes the phenomena resulting from decomposition effected *within* the earth's surface, by the electrizing principle of the sun's rays. Among these, the most striking are, (1st.) the *developement* of the grand volume of the *electrical fluid*, or elementary fire, distributed over the surface of the globe, the prime source of all the inductions which regulate the electrical states of the atmosphere, and the various mutations of the weather.—(2d.) The separation of the principle of *magnetism*.—(3d.) The *oxidation* of *metals*; a process which may be considered as the natural and grandest development of the voltaic electricity; and which, in all probability, includes among its more awful phenomena, earthquakes, and the eruptions of volcanoes.—(4th.) The *formation of metallic bodies* by the laboration of one of the constituents of water,—*hydrogen*. This idea is purely hypothetical: it may never be proved to be founded in fact; but as some have advanced the opinion, that the base of hydrogen gas is a metal, I conceive myself fully authorized to invite inquiry into the converse of that opinion. In Sir Humphry Davy's Lecture before the Board of Agriculture, (*Agric. Chem.*, page 180,) we meet with the following observations. "The veins which afford metallic substances are fissures, vertical, or more or less inclined, filled with a material different from the rock in which they exist. This material is almost always crystalline; and usually consists of calcareous spar, fluor spar, quartz, or heavy spar, either separate or together. The metallic substances are generally dispersed through, or confusedly mixed with these crystalline bodies. The veins in hard granite seldom afford much useful metal: but in the veins in soft granite and in gneis, tin, copper, and lead are found. Copper and iron are the only metals usually found in the veins in serpentine. Micaceous schist, sienite, and granular marble are seldom metalliferous rocks. Lead, tin, copper, iron, and many other metals, are found in the veins in chlorite schist. Grauwacke, when it contains few fragments, and exists in large masses, is often a metalliferous rock. The precious metals, likewise iron, lead, and antimony, are found in it; and sometimes it contains veins, or masses of *stone coal*, or coal free from bitumen. Limestone is the great metalliferous rock of the secondary family; and lead and copper, are the metals usually found in it. No metallic veins have ever been found in shale, chalk, or calcareous sandstone; and they are very rare in basalt and siliceous sand-stone."

If we attentively consider the foregoing passage, we can scarcely

fail to perceive, that metals are chiefly found in veins, the direction of which seems to indicate the disruption of the rocks through which they pass, by the agency of water. The metallic substances are found dispersed among the crystalline bodies, which, it may be remarked, are composed of substances closely allied to that *silex* that Mr. Hume considered to be *identical with oxygen*, (see 101.) Mr. Hume may not have established his theory to the very letter; but he has the triumph of finding it now admitted on all hands, that *silex* contains nearly 50 per cent. of oxygen; and that its base is *inflammable*, and probably metallic: this base Sir Humphry Davy names *silicon*. If, then, *silex* be an oxide of silicon, why may not its base, as well as the oxygen, with which that base is combined, be derived from *water*? If it be,—then *silex*—that “multifarious cement,” as Mr. Hume styles it—that grand and boundless depository of elementary fire, is neither more nor less than an *oxide of hydrogen*. No objection can be raised on account of the dissimilarity in point of form and texture; the diamond, the hardest known substance in the world, is a *combustible*, and may be converted into a gaseous fluid; nor can we conceive it more improbable, that the elements of water should assume the solid form, than that one of them, the *hydrogen* should in the form of gas, become the lightest of all bodies that possess weight. I would fearlessly hazard the conjecture, that every inflammable body in the creation is either derived from hydrogen alone, or that it contains it, in one of its definite proportions; and, to support the conjecture, I, in the first place, refer to a note at No. 350 of PARKES’ *Rudiments*, p. 176. “The fixed alkalies, which were formerly imagined to be simple substances, are proved by Sir Humphry Davy to be metallic oxides. He has succeeded also in decomposing four alkaline earths; barytes, strontites, lime, and magnesia, the base of which he finds to be metallic substances of the colour of silver. He has likewise announced that he has reason to believe that *sulphur* and *phosphorus* are compound bodies, consisting of oxygen, *hydrogen*, and their peculiar bases.” Again, one of the public lecturers, announced that Mr. Faraday of the Royal Institution, discovered, that when *potass* is acted upon by some of the *metals*,—*zinc* particularly,—a portion of *ammonia* was always generated\*. The utmost caution was used to secure the

\* “The following experiment related among others, by Mr. Faraday, is strongly in favour of the compound nature of *asote*. An empty tube was filled with hydrogen gas, and zinc foil and a piece of hydrate of potash, were put in it. It is evident that the only elements present were zinc and potassium—with oxygen and hydrogen, forming the water of the *hydrate* of potash; and yet, on the application of heat, *ammonia* was evolved, as indicated by moistened turmeric paper, placed in

purity of the substances employed, but did not prevent a similar recurrence: ammonia was always found. Now, on the old principle of the simple elementary nature of the metals, no ammonia *could* exist in the substances examined; but, if the *base* of metals be *hydrogen*, then, as potass contains oxygen, the materials of ammonia may be traceable: this, however, will involve another condition; and with it, the confirmation of another of Sir Humphry Davy's conjectures,—that *Azote*, (one of the constituents of ammonia, see No. 100,) is *an oxide of hydrogen*. I will not, however, anticipate inquiries, which of right attach to subjects referrible to the Section on the atmosphere.

The presence of the alkalies in the ashes of plants, alluded to at No. 90, appears to furnish the most conclusive evidence in favour of the agency of hydrogen in the formation of metals, for to what other source can we trace these alkaline substances? It may be contended that plants absorb them from matters in the soil, and particularly in the manures employed; but ferns, and many other wild plants, and underwood of all descriptions, grow in places where manure is never by any chance applied; and yet such plants and shrubs produce abundance of potass. What, then, is the source of these metallic oxides? Can it be the *oxygen*?—If the answer be in the affirmative, then oxygen must form an *oxide of itself*,—a thing impossible; for substances possessed of one common electricity, refuse to unite. Can it be from the *carbon*? This substance is a distinct product of incineration, or burning, as well as the alkalies; they possess no sensible property in common. What is left, then, but the *hydrogen*, or the small proportion of *azote* which is traceable in some plants?—but what is azote? They who *know* what it is, are alone fully qualified to assert, that it is not an *oxide of hydrogen*. But plants,—though these alkaline substances cannot be traceable to any of *their own* constituent parts, may absorb such substances from *the soil*; and, indeed, Sir Humphry Davy shows that alkalies do occasionally exist in the soil; two things, however, must be considered;—first, that it is in the *ashes* that alkalies are found; and, second, that the quantities yielded by different plants vary so much, that it may be considered as very doubtful, whether alkalies, purely such, exist at all in the vessels of the living plant. According to the table in DAVY'S *Agric. Chem.* (page 104), 10,000 parts of oak yielded but 15 parts of potass, the *upper part* of the tube. In this experiment, then, ammonia, which is well known to yield azote by its decomposition, appears to have been formed without its presence; and if so, the azote must have been derived from the combination of the elements enumerated.”—See *Penny Cycl.*, Article *Azote*, vol. iii., 207.

The above is the experiment alluded to by the Lecturer,

while the same quantity of fern, wormwood, and fumitory, yielded respectively 62, 730, and 790 parts. There is much of astonishing mystery in all these natural phenomena; but it appears to me, that the more we press our inquiries, and the deeper we go in our researches, into first principles, the more evident cause do we find for believing, that nature has formed all her decomposable productions from the elements of that universally diffused fluid,—*water*; and that, in effecting these surprising transmutations, she has employed but one primary agent,—the electrizing principle of the sun's rays.

(c.) The third head, comprises the phenomena which attend the decomposition of water in the immediate neighbourhood of the spongelets, and remotest fibres of the roots of plants. Their food requires preparation: manures are deposited in the soil, and these must be laborated by the process of fermentation; and that process is effected by the decomposition of water. Carbon (*charcoal*) constitutes one of the most important parts of vegetable aliment, and it is totally insoluble in fluid water; but of this fact, experience appears to warrant a doubt: plants which bleed, (as the vine,) just prior to the expansion of the leaves, yield drops, like tears, that may be collected. If these be made to fall into a phial containing pure lime water, no milkiness, or chalky deposit is produced, that I have been able to detect; were *carbonic acid* present, pellucid lime water would instantly reveal it. The pores also in the fibres are so very minute, that no solid food can by any possibility, be supposed capable of passing into them. Sir Humphry Davy (*Agric. Chem.* 243) says; "I tried an experiment on this subject; some impalpable powdered charcoal, procured by washing gunpowder, and dissipating the sulphur by heat, was placed in a phial containing pure water, in which a plant of peppermint was growing: the roots of the plant were pretty generally in contact with the charcoal. The experiment was made in May, 1805; the growth of the plant was very vigorous during a fortnight, when it was taken out of the phial; the roots were then cut through in different parts, but no carbonaceous matter could be discovered in them, nor were the smallest fibrils blackened by the charcoal, though this must have been the case had the charcoal been absorbed in the solid form."—If we consider all the facts stated in this extract, we can scarcely doubt that some powerful agent, such as the *descending* currents of solar and atmospheric electricity, by day and night, must induce those chemical affinities, by which the constituents of the manures form new compounds exactly suitable to vegetable nutrition. Our views must also be extended: for, not only is the food prepared, but electric agencies are simultaneously

developed; and these constitute the *ascending* current which propels and carries forward the aliment, so prepared, and deposits it in the vessels appropriated to the purposes of assimilation and distribution. It must ever be recollected that no one state of electric excitation, can, by any possibility, exist, without exciting another of an opposite character. If these be excited in masses, they exhibit the *attractive* and *repulsive* powers of electricity: such are, without exception, the ordinary phenomena produced by the electrical machines and apparatus in common use among electricians: but if the divellent powers (from *divello*, to separate,) of natural electricity be excited,—those that induce the nicest and most subtile processes of chemical decomposition and affinity, among mixtures consisting probably, of six or eight *binary* and *ternary* compounds, (terms expressing the union of opposite substances—such as *acids* with *alkalies*,—*hydrogen*, with *carbon* and *oxygen*, &c., in certain definite proportions); the several electricities so disturbed and developed, by changing and interchanging relations, produce effects, which must startle the most apathetic mind, if but one ray of light dart through it, so as to reveal a glimpse of the wondrous work,—and yet, these divellent powers *are* excited, and *have* induced such surprising changes in every common heap, or compost mass of fermenting materials, daily, and from the earliest period of time.

I have thus endeavoured to recall to the reader's recollection the influence of electric induction, as experimentally demonstrated in natural phenomena, with a view to render as perspicuous as possible the mode by which the nutritive fluids are prepared, and carried into the minute vessels of the root: it remains to condense the substance of what has been said, and to bring it into the form of a *theory of vegetable nutrition*; but previously, I again refer to the experiments of Dr. Faraday; they evince that a volume of electricity enters into every compound matter, and forms the bond which ties its components together.

The oxygen and hydrogen gases developed by the decomposed water, seize upon the carbon produced by the decomposition of the manures, and form gaseous bodies, consisting of carbonic acid, carbonic oxide, and carburetted hydrogen; ammoniacal gas, is also frequently evolved, and a variety of liquid compounds are produced, at a time, and in a state, the most suitable to the purposes of vegetable intromission. (See No. 16). Electricity is also developed during these processes, and serves to propel the aliment into the finest vessels of the plant. Thus Dutrochet's first theory—that of *electric currents*—is corroborated, and these, at the same time are proved to be coincident with the laboration of the food, and with its

introsusception into the vegetable pores and tubes. This word, *introsusception* (from *intro*, within, and *susceptio*, a taking up), and another, in frequent use, *capillary* attraction (from *capillus*, a hair), through tubes, fine as a hair—are terms which imply a cause or causes in active operation; but according to their usual acceptation, they express phenomena the causes of which remain involved in mystery. Do not these phenomena result from electrical currents? and as no effect can be produced without an efficient cause, may we not find that cause in the agency of electric propulsion\*, induced by electric attraction? I think we may, and that such agency will fully elucidate all the phenomena of introsusception and capillary attraction,—effects which can be explained or accounted for by no other agency whatsoever.

104. *General properties of water.* Water is said by Parkes to exist in four separate and distinct forms: “viz. in the state of ice; in that of a fluid; in the state of vapour; and in the state of chemical combination with other bodies. The most simple form in which it is probable that water will ever be exhibited, is that of ice; for by the mere combination of ice with caloric, fluid water will be formed, and a further portion of caloric will convert the fluid into steam; the most attenuated aqueous vapour being nothing more than ice divided and rarified by the solvent and expansive power of caloric.”—(*Essays*, vol. i. 361.) This opinion should be received with some caution, for it is founded entirely upon the doctrine of *latent caloric*; a doctrine which, if examined with that degree of critical acumen its assumptions seem to require, will scarcely be able much longer, to furnish satisfactory evidence of being founded upon philosophic truth. The electrolyzation of water and the developement of its elements, by the passing of a definite quantity of voltaic electricity, has opened the road to truth, and leaves the mind free to trace effects to real causes.

*Ice* differs essentially in its characters from those of water; and the phenomena which the latter displays in its approach to the freezing point, are remarkably different from those of other fluid bodies. Water contracts in cooling, and increases in density till it is reduced to about 40° of Fahrenheit: below that point, it *expands*,

\* The reader who possesses an electric machine may readily convince himself of the influence of propulsion, by means of a small apparatus termed the electrical pail; it is a little brass bucket, to be suspended from the conductor by a chain; a small tube projects horizontally from one side, near the bottom. If water be put into the pail, it will scarcely ooze through the fine orifice in the tube; but the instant that the machine is excited, the water is projected in a well defined stream, of an inch or more in length.

and becomes less dense. Ice is lighter than water, and consequently floats upon it. Its expansive force is such, that heavy pavement stones are raised, trees are split, and rocks rent asunder by it. By this expansion the most beneficial effects are produced on the soil; for as every interstice is occupied by the water, the act of freezing forces the particles of the soil apart; and as these possess no elastic property, they are found when the thaw takes place, to be broken up, more finely divided, and in a state much more manageable by the labourer, and in every respect better prepared for the purposes of vegetable growth.

105. *Ice and snow are bad conductors* of electricity. At  $13^{\circ}$  below zero, ice becomes a non-conductor, and at a much lower degree of temperature, it has been found to be an actual electric, affording sparks of fire, upon being excited. Is it possible then, that a substance, which as a solid, is specifically lighter than the fluid upon which it floats—which, when its temperature is very much reduced, may be ground into powder so fine, as to be blown about by the wind—and which from being a very ready *conductor* of electricity, has become itself an excitable *electric*; can this substance be identical with a fluid, possessing properties altogether dissimilar? And shall we, when our feelings, and our instruments convince us that the *aqueous vapour* held in invisible solution in the atmosphere during the coldest day of winter; when our thermometers demonstrably prove that this vapour, and the ponderous masses of solid ice, six or eight inches thick, are both, at one and the same individual moment, reduced to a temperature of  $8^{\circ}$  or  $10^{\circ}$ ; shall we, under such circumstances, with such evidence, be constrained to acknowledge, that “the most attenuated vapour is nothing more than ice, divided and rarified by the solvent and expansive power of caloric?” Such *may* be the fact, but of what value then are our instruments? I would rather suggest that ice, water, and vapour, are bodies possessing different electric conditions; and that, as chemical changes depend upon electric agency, the three are essentially different, and must remain so, till atmospheric changes take place, antagonist to those which had induced the various phenomena of frost.

106. *In the fluid state, water possesses a solvent power*, which, when exerted in the soil, is of great importance. Plants will not continue to vegetate, unless their roots are supplied with water; and if they be kept long without it, the leaves will droop, and assume a withered appearance. Tulips, hyacinths, and a variety of plants, with bulbous roots, may be reared, if the roots be merely immersed *in water*. Du-Hamel, Bonnet, Van Helmont, and Boyle, con-

tended, "that water, by virtue of the vital energy of the plant, was sufficient to form all the different substances contained in vegetables. The result of a great variety of experiments is, that water is not the sole food of plants, and is not convertible into the whole ingredients of the vegetable substance."

107. *In the state of vapour*, water is estimated to occupy 1400 times its original bulk, but its volume is increased to 1728 times when it exists in the state of visible *steam*. It is a permanently elastic fluid in the state of vapour, and as such, exists in the atmosphere, appearing to be incapable of again becoming fluid water, till it undergoes a change in its electric condition. "The conversion of bodies into the state of vapour, as well as the condensation of vapour, is generally attended by some alteration of their electrical condition; and the bodies in contact with the vapour are thereby rendered electrical. Thus, if a plate of metal strongly heated, be placed upon a gold-leaved electroscope, and water be dropped upon the plate, at the moment the vapour rises the leaves of the electroscope diverge with negative electricity. The general fact was noticed by Laplace, Lavoisier, and Volta, in the year 1781; and was found to extend both to solids and to liquids passing into gaseous form." "In general, it is found that the vaporization of water, by simple ebullition, produces negative electricity in the remaining fluid, or vessel, which contains it: the vapour itself being positive. On the contrary, when aqueous vapour is condensed into water, it becomes negative, leaving the bodies with which it was last in contact in a state of positive electricity."—*Treatise on Electricity, of the Library of Useful Knowledge*, p. 55.

As vapour is considered one of the constituents of atmospheric air, it cannot, with propriety, become a subject of investigation in the present section. Enough has now been said to afford satisfactory evidence, that water, whether it be considered as a mild and bland fluid, or as a decomposable medium, exhibiting the most tremendous phenomena, is of so much importance in the economy of creation, as to establish its right to take rank as second only, among the most influential agents of nature.

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## SECTION II.

## PART I.

NATURAL HISTORY AND CULTIVATION OF ESCULENT  
VEGETABLES.

## OF THE CABBAGE TRIBE.

Subject 1. *BRASSICA OLERACEA. Cruciferæ. Class xv. Order ii. Tetradynamia Siliquosa, of Linnæus. Capitata eliptica, of Decandolle.*

108. The *cabbage* is one of the most ancient of our esculent vegetables; *the tribe* includes an extensive assortment of varieties and subvarieties, all, probably, proceeding from one common origin. Some of these must have been known in the time of the Saxons, as White, in his "*Natural History of Selborne*," says that they named the month of February "*sprout-kale*." It appears probable that the Romans introduced the Italian cabbage into South Britain. The native cabbage grows wild on the sea-shore of different parts of England; it is a biennial, and flowers in May and June. The *leaves* are glaucous, (sea-green,) rather fleshy, very smooth; lower ones large, lyrate, (lyre-shaped,) waved; the upper ones oblong, toothed, or nearly entire. *Flowers* in longish clusters, bright lemon-colour. *Calyx-leaves* a little spreading, but straight; close at the bottom. *Pods* cylindrical, smooth, without a beak. *Seeds* large and globose. (SMITH'S *Eng. Flora*; also, *Enc. of Gard., Brassica*.)

109. *Var. I. Common white cabbage, Br. oler. var. capitata*, produces firm white heads, green, or greenish yellow externally, but white within. It contains about twenty sub-varieties, of which the best and most suitable to moderate sized gardens, are the

Early York, dwarf,  
London medium,  
Sugar-loaf, early,

Downton,  
Varrack,  
Battersea, early.

As the cabbage is a biennial, the chief or early summer crop is to be sown in the preceding autumn; but the later summer and autumn crops, to come in from July to the end of the year, must be the first noticed, and the directions will be given very particularly.

110. *Spring sowing.* Towards the close of March, during April, and even early in May, cabbage seed may be sown: the quantity, and frequency of repetition must depend upon the consumption.

but with good management, one sowing in April will furnish an abundant supply for a family of eight or ten persons. Prepare a spot of ground of sufficient extent to admit of three or four drills, of about fifteen feet long, for each sort of cabbage that may be preferred. This ground need not be manured, but it should be well digged and finely pulverized. Set the line about nine inches within the edge of the bed, and draw a drill an inch deep, as straight and true in depth as possible; then make the bottom of the drill firm and even by pressing a long round pole upon it; or by beating it with the back of a wooden-headed rake. Sprinkle the seeds evenly, but not very thickly, along the drill. Make another drill about nine inches from the former, and so proceed with one sort of seed till enough of that be sown; then draw the loose earth into each drill, and press it firmly upon the seed with the spade. Proceed thus with every variety, and between each bed a path of full fifteen inches (in addition to the nine inches on each side of the drills) should be allowed. Mark with a stick, or cutting, the boundaries of each variety; cut the edges of the little beds perfectly even, and then dress the surface with the back of the rake. The earlier and dwarf sorts may be sown in March; the later and large sorts in April; but it will be prudent to begin early, as the seed sometimes fails. Keep every variety quite separate. When the plants appear, thin them to about an inch apart; and shortly afterwards clear the beds of weeds with the Dutch hoe; for this purpose choose a sunny day, as the heat will speedily kill the weeds; do not, however, trust to that, but rake off every weed as each bed is hoed. As the plants advance, thin them to two inches apart; and when they have three leaves, two inches broad, prepare a nursery bed for each sort, about four feet wide by twenty-five feet long. Spread some rich compost manure on the surface, and then dig it well in, breaking the earth very fine, the whole *length* of the bed, but only to the *breadth* of two feet. Mark the outer edge of the bed, and at nine inches from that edge stretch the line tightly. Raise the plants one by one with a setting-stick, or the garden trowel, and select plants as nearly of a size as possible. Set about forty in the row, by the planting-stick, or trowel, and let the earth be brought close round the roots and stems, and as high nearly, as the base of the lower leaf. Set out the plants six inches apart, and when one or two rows are planted, dig another space for two more rows, and proceed thus till six rows be completed; then cut the edges of the bed smooth and even by the line, at nine inches from each outer row. Give each plant a quarter of a pint of soft water, pouring it into the hole from the spout of a pot held nearly close to the stem. *Fine pulverization*

is assuredly the greatest security for successful planting; and if the evening be chosen for the time of pricking out, repeated watering need seldom be resorted to. It will be remarked, that I have directed the bed to be digged *by portions*; most persons do the whole digging before they begin to plant. I have adopted and recommended the above plan, to prevent the evil of treading on ground that has been worked. There will now be 240 plants in six rows, and the bed will be four feet wide; after which, a small foot-path cut out, and made level between this first bed and another piece of ground, will give space enough for the due separation of the several sub-varieties of the plants. By observing these directions, (which will apply to *savoy*s, *borecole*, and *broccoli*,) a double object is attained; 1st, the nursery beds are set out with precision and neatness; and 2nd, the ground is not trodden into holes; which it always must be, when the digging is finished in the first instance. If the weather be very dry, the new beds will require two or three waterings early in the mornings, or after sunset; and should any plant fail, it must be replaced by another from the seed bed. If a considerable number of plants still remain in these *seed beds*, it will be prudent to raise them all with the trowel, and reset them by the line in regular distances of eight or nine inches apart, in their own ground. This operation will give the plants a check, and prevent them from acquiring long forked roots and straggling stems; the roots will become fibrous, or stocky, and the plants will be in regular order and ready to be set out, when those in more manured ground will be advancing to the state of cabbages. As the plants in the nursery-beds increase in size, transplant them at different periods of May, June, and July. Set out, and dig the beds as directed above, raise the alternate plants of the nursery-beds, and plant them in the new beds, where they are to remain. As to distances, the smaller sorts should stand twelve inches, the middling-sized sixteen inches, and the large Yorks, sugar-loaf, &c. from two feet to thirty inches apart, every way. Whenever plants are set out, whether it be with the dibber, the trowel, or the spade, the utmost care must be taken to bring the earth close to the *bottom*, and about every part of the roots; and if these roots be covered with knobs or tubercles, they must be trimmed with a knife, to remove all the excrescences; and if there be good fibres *above* the injured part, the whole below the fibres, should be pruned off. Set each plant as deep as the butt or base of the lower leaves; hold it in the left hand, work the planting tool about the roots, till it so press the earth about them, that the plant will resist a gentle pull; *and then, all being secure, make the ground neat. This neatness*

can always be produced by an adroit use of the garden trowel at the time of planting; patting and smoothing the soil without pressure, about and around each plant; method and experience, by the aid of a quick discerning eye, will effect any thing.

*In the seed-beds* the plants, if kept clean and hoed, will, at various periods, be fit for transplanting; and thus by management of the three departments, that is, of the seed-beds, the nursery-beds, (the plants in which should from time to time be thinned till they stand at from twelve to sixteen inches apart, or more, according to the sort,) and of the transplanted cabbage-beds, there will be a constant and various supply for the table from May to November or December. In fact, from the seed-beds, by transplanting as late as September and October, I have had delicious cabbages; not large, but firm, clear, and green, in the following spring.

111. *The main crops* of what are termed summer cabbage, must be managed somewhat differently; and observe, that very nice attention must be paid to the period of sowing, for if that be too early, the plants may run to seed, and if too late, they can hardly acquire sufficient strength in time to become *early cabbage*: the last week in July, and the first week in August afford, pretty nearly, the limits for this operation; so experience has determined. The early York alone, or the early York and London, and early sugar-loaf, and Downton, may be sown as directed for the spring sowing; the subsequent management is to be the same, and at the final transplantings, the plants may stand at similar distances. In September, the nursery-beds should be made, and the plants finally placed out in October and November. If the winter prove mild, and the ground be in good heart, this mode will bring firm good cabbages in April and May; but as the season may prove severe, it will be safer to leave the greater part in seed and nursery-beds; for if severe frosts occur, the small space occupied by the plants therein can be easily protected by coverings of fern leaves, long litter, or branches of evergreens. The plants so treated, are to be finally set out in February and March in rich earth. If the weather prove very mild in November, or indeed at any period betwixt November and February, the plants finally set out, may become too forward; to prevent that, raise them up with a spade, and reset them in the same spot immediately. Hoe the seed and nursery-beds, so as to kill all weeds: and as to the cabbage-beds, dig deeply once or twice in dry weather, those in which the plants stand at the greatest distances; and hoe those in which the plants stand too close to each other to admit of digging; draw earth also to the stems of the plants, particularly when the cabbages begin to form their heads;

earth them well up, and then dig or hoe as deeply as possible between every other row; in a week afterwards dig or hoe the other spaces; and so on every week alternately. These diggings open the ground, and tend to promote those decompositions which produce and propel the nutritive matters. (See Number 103, c.) But if the weather be hot and parching; and if all the intervals be digged at one time, too many fibres will be cut and separated; hence a great check will be given, which may be avoided by effecting the work at two separate periods.

112. *Soil and Situation.*—"The soil for seedlings should be light, and excepting for early sowings, not rich. Where market gardeners raise great quantities of seedling cabbages to stand the winter, and to be sold for transplanting in the spring, they choose in general, the poorest and stiffest piece of land they have got, and especially in Scotland, where large autumnal sowings of winter drumhead, and round Scotch, are annually made, and where the stiffness of the soil gives a peculiar firmness of texture and hardness of constitution to the plants, and prevents their being thrown out of the soil during the thaws which succeed a frosty winter. Transplanted cabbages require a rich mould, rather clayey than sandy; and Neill and Nicol observe, it can scarcely be too much manured, as they are an exhausting crop. Autumnal plantations, intended to stand the winter, should have a dry soil, well dug and manured, and of a favourable aspect. The cabbage tribe, whether in the seed-bed or final plantation, ever requires an open situation. Under the drip of trees, or in the shade, seedlings are drawn up weak, and grown crops are meagre, worm-eaten, and ill-flavoured."—(*Encyc. Gard.*, 3491.)

113. *Saving the Seed.*—It is very difficult to raise seed free from any mixture or crossing; if attempted, select one or two of the best cabbages, and transplant them in autumn, setting them in the ground up to the head; early next summer, abundance of seed will be yielded. "A few of the soundest and healthiest cabbage-stalks, furnished with sprouts, answer the same end. When the seed has been well ripened and dried, it will keep for six or eight years. It is mentioned by Bastien, that the seed growers of Aubervilliers have learned by experience that seed gathered from the middle flower-stem produces plants which will be fit for use a fortnight earlier than those from the seed of the lateral flower-stems: this may deserve the attention of the watchful gardener, and assist him in regulating his successive crops of the same kind of cabbage."—(*Idem*, 3508.)

If the ground be digged in March or April round about the plants, the maturing process will be assisted. Whether the ripe

seed be kept in the pods or threshed out, it should be preserved in a very dry situation.

Sir Humphry Davy, in his *Elements of Agricultural Chemistry*, states that in 1000 parts of cabbage, 73 parts are the whole quantity of nutritive soluble matter, of which 41 are mucilage, or starch, 24 saccharine matter, or sugar, and 8 gluten, or albumen; of course 927 parts out of the 1000 consist of watery or innutritive matter.

114. *Cabbage coleworts*, for a supply of winter and early spring greens, are to be raised by forming seed-beds of some of the hardiest middle-sized, and early sub-varieties, on the plan before described, but not till the end of June; and thence to nearly the last week of July. Transplant finally in August and September, in rows fifteen inches asunder, and the plants nine inches apart in the rows. Keep the seed-beds and plantations quite clean, and draw earth to the stems of the latter; after which, hoe deeply between the rows. If any plants should fail, supply their places from the seed-beds. Some of the most forward will be fit to draw as greens throughout the winter months; others will succeed in March and April, and some may form small cabbages in May.

Subject 2. RED CABBAGE:—*Bras. Oler. var. β. rubra.*

115. *The red or purple cabbage* has three principal sub-varieties; viz. the large red, or Dutch; the small red, with a firm round head; and the Aberdeen red. They are chiefly used for pickling, are sometimes shredded as beet-root for salad, and are prepared as sour krout by the Germans.

*The sowing and culture* are in all respects the same as for the white cabbage. Sow in August; transplant in the fall, and allow somewhat more space than for York cabbages. The heads will be produced early the following summer, and will be firm and hard towards the close of it. Sow also in spring for a late crop in the succeeding autumn; but these, it is likely, will not be so large and fine.

Subject 3. SAVOY:—*Bras. Oler. var. γ. sabauda.*

*Bullata major*, of Decandolle.

116. *The Savoy* is a winter cabbage: the best and staple supply from November to March: it is distinguished from all the other varieties of firm-headed cabbages, by the roughness of its leaves. There are three principal sub-varieties:—the *green*, the *dwarf*, and the *yellow*. The first is a sweet and excellent sort; the yellow is by some preferred, and may form the main winter crop, but is not so

delicate as the green; the dwarf is hardy. The savoy requires deep digging or trenching, and the soil should be rich and light. To sow a seed-bed of four and a half feet by eight feet, half an ounce of seed is the quantity that may be considered as sufficient, provided the seed be sound and good.

*Propagation and culture.*—Observe the directions given for white cabbage, No. 110. A few seeds may be sown in February, to produce savoy in the early autumn; another supply may be provided for, by a sowing in March; but the main crop is to be sown in the middle of April. Another small sowing for winter greens, may be made in May. Nursery-beds and final plantations should be prepared for the main crop in May and July; but savoy do not absolutely require to be twice removed. If nursery-beds be formed, the plants should stand at six or eight inches apart therein; and in July, when they are to be finally set out, they should be allowed at least two feet space every way. The small dwarfs will do with eighteen inches, but the large yellow should have two and a-half feet.

For subsequent culture, hoeing, digging, and saving the seed, see Nos. 110, 111, and 113.

Subject 4. BRUSSELS SPROUTS:—*Bras. Oler.* a sub-variety of the *Savoy*. *Bullata gemmifera*, of Decandolle.

117. The Brussels sprouts produce tall stems three or four feet high, with a head somewhat like a savoy, but of little value: from the axils or base of the leaves, arise small green heads, like little cabbages, about one or two inches in diameter; they are highly spoken of by Van Mons, and recommended by Nicol and Morgan.

*Culture.* (*Encyc.*, No. 3524.)—"The plants are raised from seed, sown in March or April, of which, an ounce may be requisite for a seed-bed of four feet by ten." Van Mons says, (*Hort. Tr.* vol. iii.) "The seed is sown in spring, under a frame, to bring the plants forward; they are then transplanted into an open border with a good aspect." By thus beginning early, and sowing successively, till late in the season, he says, "We contrive to supply ourselves in Belgium with this delicious vegetable, full ten months in the year; that is, from the end of July to the end of May." The plants need not be placed at more than eighteen inches each way, as the head does not spread wide, and the side leaves drop off."

With us, the Brussels sprout is so hardy, that it will stand 20° of frost, and its head, about Christmas, is a tender and delicate species of greens. Being then cut, the plant will remain nearly

torpid till the advancing sun causes it to start into new vegetation; then, the spaces between the rows should have a little leaf-soil, or good manure lightly forked in; and the young heads, all of which were quiescent, but visible in the winter, will speedily advance from the axils of the leaves, and yield a supply for many weeks, if they be properly pulled or cut in succession.

Mr. Cobbett (*Eng. Gard.* 127) says, "The plant that has generally had this name given to it in England, is a thing quite different from the real Brussels sprouts. If you mean to save seed, you must cut off this crown, and let the seed-stems and flowers come out nowhere but from the little cabbages themselves. It is most likely owing to negligence, in this respect, that we hardly ever see such a thing as real Brussels sprouts in England; and it is said that it is pretty nearly the same in France, the proper care being taken nowhere, apparently, but in the neighbourhood of Brussels."

Subject 5. BORECOLE:—*Bras. Oler. var. δ. sabellica. Acephala Sabellica*, of Decandolle.

118. *The borecole* contains many sub-varieties, fourteen of which are named by the *Encyc. of Gardening*. These plants are, in general, peculiarly hardy: they resist frost, and retain their green appearance throughout the winter: hence their value as winter greens. For cultivation in general, three of these sub-varieties are selected, and these are,

The *German Kale*,  
The *Chou de Milan*,

The *Woburn Kale*; a very distinct vegetable, and a perennial.

*Propagation and culture*.—The two first sorts, and indeed all the common sorts, are raised from seed sown in March and April; one ounce, according to Abercrombie, will sow a bed four feet by ten in extent.

The *German Kale* is peculiarly valuable, because it produces a copious supply of shoots and sprouts from the axils of the leaves after the head is cut off. The heads form the first cuttings, after which, the stems furnish a succession till spring-greens come in; the leaves should be trimmed off as soon as the head is removed. The *Chou de Milan* is highly valued by some persons, and it also furnishes a succession; the other sub-varieties must be pulled up and removed as soon as the heads are cut. Sow the seeds, transplant into nursery and final beds, as directed for spring cabbage; only observing that two and a half feet must be allowed when the plants are finally set out. From June to August, succession beds may be formed, and these will furnish a constant supply during January, February, March, and April, of the succeeding year.

119. *Woburn Kale* is propagated by cuttings, six or seven inches long: these readily take root, and the season for the work is March and April. “About the beginning of April, or as soon as winter-greens are out of season, the stems (of this kale) are to be cut down to the ground within two buds of the roots: the soil is then slightly forked over, and afterwards kept clean of weeds by the hoe.”—(LOUDON, from *Hort. Trans.* 3535.)

Dig between the rows of each of the three sorts, after all the heads have been cut.

Subject 6. CAULIFLOWER:—*Bras. Oler.* var. *c*, botrytis.  
*Cauliflora* of Decandolle.

120. The *Cauliflower*, “Choufleur” of the French, is esteemed the most delicate of the cabbage tribe: it is an annual, and produces its flower in the autumn, if sown in the spring. “Till the time of the French revolution, quantities of English cauliflowers were regularly sent to Holland, and the low countries; and even France depended on us for cauliflower-seed; even now, English seed is preferred to any other.”—(*Encyc. of Gard.*, 3539.)

*Propagation and culture.*—The *white* sub-variety is the most delicate: the *red-stalked* is esteemed more hardy. Half an ounce of seed is allowed for a bed four and a-half feet wide, by ten feet in length. The *main crop* is that which is destined to stand the winter, and to furnish the early summer supply; great expense and trouble have been bestowed to secure this tender plant; hence, it is desirable to find some mode of giving it a degree of hardihood capable of resisting the frost of our ordinary winters. “Ball finds that if cauliflower seed is not sown till the last week in August, and that if the seedlings are not transplanted till the middle, or near the end of November, before the hard weather sets in, no sort of covering is necessary, nor any other protection than that afforded by a wall having a south aspect. In such a border, and without any covering, young cauliflower plants have uniformly stood well for many successive winters, and have always proved better and sounder plants for spring planting than such as have had additional shelter. Cauliflower plants, it is probable, are often killed with too much attention. Seedlings raised in autumn seem to be very tenacious of life.” It certainly seems highly desirable to avoid the trouble, and heavy cost, of bell-glasses; a mode of culture scarcely feasible by the domestic gardener, who may well shrink from that, which with loss of time, and breakage, must be supposed to enhance the price of each head to at least a shilling; for in the month of November, four, five,

or six plants, are placed under hand or bell-glasses, which are to be constantly removed in fine weather, and at other times, according to the vicissitudes of the season, raised on the south side, or supported on bricks, to permit of the needful access of air during the day. These glasses must be closed down during the nights, and also in rigorous weather, when an additional covering, or extra protection of mats or litter, will be required. Finally, at the approach of spring, the weaker plants are removed, more air is given, and at length the plants having grown so as to fill the glasses, are wholly exposed, and being earthed up, are left to mature their heads. One plant only, the finest, should remain, and the earth should be formed into a kind of dish round each stem, to contain water, or rather liquid manure, as the cauliflower is, what is termed, "a foul feeder."

121. *Spring sowings*.—The first may be made early in March in a moderate hot-bed, or under a frame, or hand-glass; these plants are to be pricked out when their leaves are an inch broad, as directed at No. 110. They are to be finally planted in the open garden early in May, at distances of two and a-half feet asunder; they will produce in August.

The *second spring sowing* for the late autumn, and winter crop, is to be made about the middle of May. Observe the same rules, and they will produce in October and November.

The *soil* for cauliflowers should be very rich; "cleanings of streets, stables, cesspools, &c., ought to be liberally supplied during the growth of the plants, when very large heads are desired;"—but good diggings between the rows once or twice; and I am inclined to believe a slight solution of *common soda*, in the proportion of about an ounce to a gallon of water, given at twice,—*i. e.* when the plants begin to show heads, and when the heads approach to maturity, would answer every purpose; and the salt is much to be preferred on account of its perfect freedom from rankness or foul smell; that is, if it be found effectual: in fact, I have *tried* these weak solutions on many crops, and never witnessed one instance of *mischief*; how far it may be really *efficient manure*, my experience as yet does not absolutely determine.

*To save the seed*, Mr. Cobbett's directions appear to be the most explicit and practically correct; for effecting this purpose, he says, "no pains that you can take would possibly be too great. First, look over your stock of heads; you will see some of them *less compact* than the others, more uneven, and more loose. "Now observe, it is the compact, the smooth, the white head, of which you ought to *save the seed*, and though it will bear much less seed than a loose

head, it will be good—you can rely upon it; and that is more than you can do upon any seed that you purchase, though it come from Italy, whence this fine plant originally came.”

When cauliflowers are near maturity, double down two or three leaves over the heads, to protect them from the sun and heavy rains.

Subject 7. BROCCOLI:—*Bras. oler.*, a sub-variety of the *Cauliflower*.  
*Botrytes asparagoides* of Decandolle.

122. According to Loudon, (3555,) the few varieties that were known in Miller's time, are supposed to have proceeded from the cauliflower, which was originally imported from the island of Cyprus, about the middle of the sixteenth century. Miller mentions the white and purple broccoli as coming from Italy; and it is conjectured that from these two sorts all the subsequent kinds have arisen.

This capital vegetable is superior to the cauliflower in two respects; in early spring it is in season, when no vermin or caterpillar is in existence; and it is comparatively hardy. Loudon enumerates, on the authority of Ronalds, of Brentford, thirteen varieties. These are arranged in the order in which they usually come to perfection. Those marked with an asterisk, are well suited to gardens of moderate dimensions.

- |                               |                                      |
|-------------------------------|--------------------------------------|
| *1 Purple Cape, autumnal,     | 8 Tall purple-headed,                |
| 2 Green Cape, do.             | *9 Cream-coloured, or Portsmouth,    |
| 3 Grange's early cauliflower, | 10 Sulphur-coloured, new,            |
| 4 Green close-headed, winter, | 11 Spring white,                     |
| *5 Early purple,              | 12 Late dwarf, close-headed,         |
| *6 Early white,               | 13 Latest green Siberian, or Danish. |
| 7 Dwarf, brown-headed,        |                                      |

123. *Propagation of purple Cape Autumnal broccoli*.—It may be sown in drills on light earth, made very rich, the seeds thinly scattered, from the middle of April to the end of June, to procure a supply from August, and throughout the winter. Maher transplants into beds where they are to remain, when the young plants have from eight to ten leaves: the beds are made very rich with manure, and not a weed is suffered to remain in them. He transplants some of the middle sowings, from the seed-beds into pots of the size *sixteen*, filled with rich compost, placing them in the shade, and watering, till they begin to grow freely. The pots are then plunged in the open ground, two feet asunder, and the rims about three inches below the surface, leaving a hollow, or basin, round each plant, to receive the water, till the autumnal rains come; when the earth is brought close round the stems, and pressed close. When the frost sets in, all the pots are removed under shelter of a frame or shed,

but the plants are permitted to have air, when the weather is milder; thus a succession is secured during the winter.

M'Leod suggests a method of growing *Cape broccoli* without transplanting. "In the end of May, after having prepared the ground, he treads it firm, and by the line, sows his seeds in rows two feet apart, dropping three or four seeds into holes two feet distance along the row. When the seeds vegetate, he destroys all except the strongest, which are protected from the fly by sprinkling a little soot over the ground; as the plants advance, they are frequently flat-hoed, till they produce their heads: they are once earthed up. A specimen of the broccoli thus grown, was presented to the Horticultural Society; the head was compact, weighed three pounds, and measured, when divested of its leaves, two feet nine inches in circumference. I have tried this method; I lost two sowings by the fly or slug, but succeeded with the third. I found, however, that the plants were so loose in the ground, that it became needful to open it, and let them down, till the earth reached half way up the stems: some manure was then placed about the roots, the earth was drawn close, and pressed firm, and some water with a little salt was given. Fine heads were produced from the last week in August till the end of October. This succession was partly occasioned by the necessity of making good some vacancies occasioned by the fly or slug; for in the third sowing, one whole drill was sown, and as this drill was finally thinned to two feet distances, the plants removed served to make good the losses occasioned by insects in the other rows, which had been dotted according to M'Leod's directions."—(See *Encyc. of Gard.*, 3587.)

124. *Culture of broccoli in general.*—All the sorts marked \* may be finally planted out in distances of two feet, excepting the *Portsmouth*, which should have a space of three feet between each plant. A *sandy* loam, well enriched with manure, and finely pulverized, is most favourable. The *seeds* (of which Abercrombie allows *one ounce* to a bed four feet wide by ten long), should be sown in April, or early in May. When the plants are six or eight inches high, they may be removed into the beds where they are to remain. Keep down every weed; earth up the plants very high about the stems, at the close of autumn; and when open, dry weather succeeds the frosts of January and February, remove every dead leaf, and dig the ground: this, if done by alternate intervals, as described at No. 111, will renew the processes of vegetable nutrition; and other circumstances being favourable, a succession of heads will be produced, from the first week in March, during six weeks or two months following. A dry and hot season from May to July, is inimical to broccoli; the

best remedy is to open trenches, nine or ten inches wide and deep, and a yard apart. Into the base of each, dig well three inches of decayed leafy manure. Plant the young broccoli, when nearly a foot high, in holes along the trenches, filled with water, and choose the evening for the work. Repeat the watering three successive times after sunset; the plants will grow vigorously, and the earth of the intervening ridges will act as shade during summer. In 1835, when crops were burnt up, broccoli so treated flourished luxuriantly. At the approach of winter, draw the ridge-soil into the trenches, and thus the stems will be protected.

125. *To save seeds.*—Wood selects the largest and finest heads, taking particular care that no foliage appear on their surface; these he marks, and in April lays them in by the heels, in a compound of cleanings of old ditches, tree-leaves, and dung. When the head begins to expand, he cuts out the centre, leaving only four or five of the outside shoots to come to seed. This method, he considers, saves the seed from degenerating, and produces seed the most genuine of all the others he has tried.

I object to this method; I tried it, as I conceived, fairly, in 1831, on a fine plant placed in a rich compost at the corner of a south-east border. The plant dwindled, and produced nothing. At the same time, another plant was preserved in the spot where it grew, and produced sound and excellent seed. In concluding this article, I remark that all the plants of the Brassica tribe appear to form excellent rotation with potatoes; the exudations from the roots of the one favour the growth of the other. Potatoes and cabbage may, I believe, be made constantly to alternate with one another.

## PART II.

### OPERATIONS IN THE VEGETABLE GARDEN, FOR THE MONTH OF MARCH.

126. *Sow*—Beans; long-pod, token, Sandwich, and Windsor, (21,) once or twice during the month.

Peas; Warwick Prussians, dwarf imperials, (24,) and Woodford's marrow, once or twice.

Lettuce; the hardy sorts. Radish; the salmon, short-top, and the red and white turnip; the two former in the first or second week; and the two latter in the third or fourth.

Small salad; every fortnight.

Spinach, or spinage; in the second week for early crops.

*Parsley*; the curled-leaved, in the second or third week.

Asparagus; *the seeds*; either in beds to remain, or to be transplanted.

Purslane, chervil, coriander, basil, dill, fennel, and any other sweet herbs;—also nasturtium,—all about the third week.

Beet-root, (73);—carrot, (75);—parsnip, (79); in the third or fourth week, for the main crops.

Cabbage, (109-10);—the red, (115);—Savoy, (116);—Brussels sprouts, (117);—Borecole, (118);—about the fourth week, if done at all this month;—also,

Turnips; the early stone, and Dutch.

Onions; the white Spanish, in drills, for a full crop.

Sea-kale; either in beds to remain, or to be transplanted.

*Plant*—Horse-radish, Jerusalem artichokes, and artichokes, in the second or third week;—also,

Cuttings, slips, and roots of balm, mint, thyme, savory; and small plants of sage, rosemary, lavender, and rue, and the roots of garlick, shallots, and chives.

Asparagus; in beds, about the fourth week.

*Transplant*—early cabbages (111); and autumn-sown lettuce; the former as early in the month as possible.

*Earth up*—peas, beans, &c.: *fork* asparagus beds, if the weather be open and dry at the end of the month: destroy young weeds, and remove litter of every kind.

## SECTION III.

### PART I.

#### NATURAL HISTORY AND CULTIVATION OF STONE-FRUIT TREES.

Subject 2. NECTARINE:—*Persica lævis*; var. *Nectarina*.

127. The *Nectarine* is considered as merely a variety of the *Peach*; it is, however, distinguished from it by the smoothness of the fruit, and the firmer texture of the pulp. Loudon observes, that the peach and the nectarine are, by the continental gardeners, considered as one fruit; and Forsyth says, “The fruit is called nectarine, from nectar, the *poetical* drink of the gods.” Some botanists, considering it as a distinct species, distinguish it by the trivial name of *nuci-persica*, from the similitude of the green fruit in smoothness, colour, size, and form, to the walnut (*nux*) covered

with its outer rind, or green shell." At 4518, *the Encyclopædia of Gardening*, enumerates eight varieties of *free-stone* nectarines, viz.:

* Elruge,	* Fairchild's early,	* Scarlet,	Murry,
* Temple's,	Peterborough,	Violent Hâtive,	White Flanders.

And eight varieties, *cling-stones*, viz.:

Late Newington,	* Red Roman,	Early Pavie,	* Early Newington,
Brugnon Italian,	Golden,	Late Genoa,	Roger's Seedling.

Forsyth recommends for a small garden, those which are marked(\*). The Elruge, Fairchild's, and Scarlet, ripen in August; the three others in September. Consult LINDLEY'S *Guide*.

*Culture, &c.* are precisely the same as for the *Peach*. (See 83, *et seq.*)

Subject 3. The ALMOND TREE:—*Amygdalus*, of Linnæus.

128. *The common almond*, or sweet almond, *A. communis*, and the *bitter almond*, *A. amara*, are both trees of great beauty, with blush-coloured, or pure white blossoms, and large spear-shaped leaves, resembling those of the peach: the chief distinction is in the fruit, the only eatable part of which in the *almond*, is the kernel.

The almond is a native of Barbary, and of most eastern countries; it is much cultivated in France, Spain, and Italy.

There are eight or nine varieties of the almond tree; but three only are valuable as fruit-bearers:

The common sweet almond,    The common bitter almond,    The sweet Jordan.

*Culture.* This tree is raised from the stones; and if intended for ornamenting the shrubbery, it need not be budded: but if *fruit* be the object, budding should be performed on almond or plum-stocks: the latter are preferable for most soils; the former for dry situations. The almond tree is peculiarly suitable to the shrubbery, and sometimes will produce fruit: it bears chiefly on the wood of the previous year, and occasionally, on short spurs of the two years' old wood: in the former respect it resembles the peach and nectarine; in the latter, the apricot, and should therefore be pruned like those trees.

## PART II.

### OPERATIONS IN THE FRUIT DEPARTMENT.

129. *Prune*—in all cases where the work still remains unfinished, and speedily; for the sap now begins to be in motion; and *if the leaves be not expanded some will lose sap.*

*Plant*—fruit trees of all descriptions; among others, the *mulberry*. Plantations of currants, gooseberries, raspberries, and strawberries, may now be made: copious flooding with water will be required.

*Graft*—all kinds of trees, throughout the month, at various periods, as the weather may indicate.

*Protect*—by mulching of cow-dung, or by littery manure, fresh planted trees; place it round the stems in a kind of basin, and then draw the earth over it, to preserve a neat appearance.

*Propagate*—vines, by layers, cuttings, or by buds or spur eyes, placed in pots, an inch deep under the mould; then plunge the pots in the ground below their rims.

*Dig*—between currant and gooseberry trees, and deeply hoe between strawberry plants.

### MISCELLANEOUS.

130. *Plant*—Box-edgings; also flowering shrubs; roses, Persian lilacs, *althæa frutex*, dwarf almond, &c. &c.

*In flower borders*, anemone and ranunculus roots, and many herbaceous plants; pinks, sweet-williams, Canterbury bells, polyanthus, auricula, dwarf gentian, daisies, &c. &c.

*Sow*—in the borders, all kinds of annual flower-seeds of the hardier species; as larkspur, hawkweed, lupin, mignonette, towards the third or fourth week. All the best kinds in pots and pans, in heat.

Keep the borders, and all the departments, very neat.

*Protect*—by covering of canvass, beds of tulips, hyacinths, anemones, &c. if violent rains, or severe frosty winds occur.

### *Garden Shrubs and Plants now in flower.*

*Shrubs.* The Almond, *Amygdalus*; Mezereon, *Daphne Mezereum*, *D. Pontica*; Rhododendron, the Dauric.

*Perennial flowers.*—Primrose and Oxlip, *Primula vulgaris et elatior*, *Primula sinensis*; Violet, *Viola odorata*; Hellebore, *Helloborus viridis*; Alpine Soldanella, *S. alpina*; Hepaticas, *Anemone hepatica*.

*Bulbs.* Fumitory, *Corydalis bulbosa*; Purple Cyclamen, *Cyclamen coum*; Early Tulip, *Tulipa tricolor*; Jonquil, *Narcissus odoratus*; Snowflake, *Leucojum vernum*; Crocus, *Cr. vernus*; Dog's-tooth Violet, *Erythronium dens-canis*; Hyacinth and Grape ditto, *Hyacinthus orientalis et racemosus*; Daffodil, *Narcissus pseudo-narcissus*.

## THE NATURALISTS' CALENDAR.

## MARCH.

“MARCH many weathers,” “March comes in like a lion and goes out like a lamb,” were the quaint but expressive sayings of those of “the olden time,” long before the alteration of the style. The sun has now gained so much power, that there is an increase in average temperature of about six degrees, and evaporation becomes very considerable. The *vernal equinox* takes place during this month, and experience seems to authorize the conclusion, that *according to the character which the weather assumes about that period, the succeeding summer will, in all probability, be either wet or dry*. Kirwan and others have given rules founded upon repeated observations, from which some probable opinion may be formed. It appears to me to be placed beyond doubt, that if north or north-east winds prevail on or about the period of the equinox, that is, from about the 18th to the 25th of the month; and especially if the barometer be high, and the mercury show convexity, that the succeeding summer will generally *be dry*. If, on the contrary, south or south-west winds prevail, if the weather be wet, and the mercury falling, the succeeding summer will, with *greater probability be wet*\*. It does not seem improbable that at the period when the sun shines perpendicularly upon the equator, illuminating the whole hemisphere, so as to cause equal day and night throughout the world; the electro-magnetism of our planet, and possibly that of the moon also, may be so regulated by the sun’s electrizing principle, as to induce a peculiar modification of atmospherical

\* Kirwan says, “If there be a storm at south-west, or west-south west on the 19th, 20th, 21st, or 22d of March, the succeeding summer is generally wet, *five times in six*.” I quote from memory, and cannot determine the grounds upon which he forms his opinion. The March of 1828 was dry and serene till the 18th, with the barometer at an average about thirty inches, but west and south-west winds generally prevailed. On the 18th, the barometer began to decline; the mercurial column fell rapidly; *cumulo-cirro stratus*, or compound, suffused cloud formed, and a south-west gale succeeded: the wind, however, veered to west-north-west early on the 19th, and during this period the equinoctial point was passed. Such were my own *local* observations: the character of the succeeding summer requires no elucidation; it was not at all local, but everywhere *wet*.

The equinoctial periods of 1829 and 1830 indicated wet summers; those on the contrary of 1831, 1832, 1834, and 1835, predicted fine, or dry summers; the *results corresponded*.

currents about the equatorial regions, that shall influence the general state of the winds in distant latitudes. There are only two periods of the year when the sun is so situated with regard to the earth, and these periods are the two equinoxes. Will it be too daring, to conjecture that, at the periods when the ecliptic coincides with the equinoctial, the sun influences the electricity, or electromagnetism of the earth, so as to induce a character or modification which shall predominate during the greater part of the succeeding year?

The average height of the barometer is about 29 in. 90 cts.

Ditto ditto of the thermometer, 44°.

*In the first week.* The frog, (*Rana temporaria*,) appears and croaks; ring-dove, (*Columba palumba*,) coos; pheasant, (*Phasianus gallus*,) crows; wryneck, (*Jynx torquilla*,) appears; yellow wag-tail, (*Motacilla flava*,) sings; duck, (*Anas boschas*,) and goose, (*Anas anser*,) lay; peacock butterfly, (*Papilio Io*,) appears.

*Second week.* The crow, (*Corvus cornix*,) builds; golden-crested wren, (*Motacilla regulus*,) sings; lady-bird, (*Coccinella bipunctata*,) appears; jack-daw, (*Corvus monædula*,) appears about churches or old trees; tortoise-shell butterfly, (*Papilio urticæ*,) is seen.

*Third week.* Black ants, (*Formica nigra*,) appear; blackbird, (*Turdus merula*,) lays; wheat-ear, (*Motacilla ænanthe*,) appears; willow wren, (*Motacilla*, or *Sylvia trochilus*,) seen; house pigeons, (*Columba domestica*,) sit; snake, (*Coluber natrix*,) appears.

*Fourth week.* The greenfinch, (*Fringilla chloris*,) sings; buzz-fly, (*Bombylius medius*,) appears; horse-ant, (*Formica herculiana*,) and flies of various kinds, (*Musca*,) appear: in early seasons some of the swallow tribe and other summer migrating birds return.

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## A P R I L.



## SECTION I.

## SCIENCE OF GARDENING.

## THE ATMOSPHERE.

131. THE grand natural agent which, next in order to water, lays claim to particular notice, is the ærial fluid that entirely surrounds our planet, and extends, as is generally believed, to the altitude of about forty-five miles. The atmosphere, as well as water, was formerly considered as one of the four elements; and even in the present advanced, or rather, advancing state of science, when the compound, decomposable nature of the atmosphere, cannot rationally be questioned, the nature of that peculiar gas which constitutes full 77 parts out of every 100 of the whole ærial volume, is still not only undetermined, but there exists a material difference of opinion on the nature of that union by which the atmospheric gases are held together;—one set of philosophers conceiving that the gases are chemically united; while another contends that their union is merely mechanical, or one of simple mixture. In this state of doubt and uncertainty, a state which proves our chemical knowledge to be still in its infancy,—such passages from works of acknowledged authority are selected, as may tend to throw some light upon the origin and existing state of received opinions.

132. *On the cause of elasticity in æriform fluids, or gases.*—Lavoisier lays it down as a law, that gaseous elasticity depends upon that of *Caloric*, which seems to be the most eminently elastic body in nature: at the same time he admits, “that this is only an explanation of elasticity, by an assumption of elasticity;” and that “we only remove the difficulty one step further, and the reason for the elasticity of *caloric* still remains unexplained.” This explanation he seems to find in the fact, “that when we produce a vacuum in a large receiver of an air-pump, the *last portion of air* which remains, extends itself uniformly through the *whole capacity* of the vessel, however large it be: a true repulsion takes place between the particles of elastic fluids; at least, circumstances occur exactly as if such *repulsion* actually existed; and we have a right to conclude, that the

particles of caloric mutually repel each other. When we are once permitted to suppose this repelling force, the theory of the formation of gases, or aëriform fluids, becomes perfectly simple; though we must allow that it is extremely difficult to form an accurate conception, how this repulsive force acts upon very minute particles placed at a distance from each other." *Elem.* vol i.

Parkes, who wrote forty years after Lavoisier, agrees with him in general principles. He says, (*Rud.* No. 40), "When solid substances are rendered permanently aëriform by heat, the air thus produced is called a GAS, to distinguish it from those aëriform substances which return to the solid or fluid state when the heat is abstracted.

"All the gases are compounds of solid matter and caloric. It is caloric which separates the particles, and gives the whole a gaseous form.

"The permanency of the gases appears to be owing to the strength of the affinity existing between caloric and their bases, which affinity resists every reduction of temperature.

"Caloric is the name which modern chemists have given to fire, or the matter of heat; a large portion of which is intimately combined with atmospheric air.

"Caloric is applied to fire, or the substance which produces the sensation we call heat, but never to the sensation itself, or the effect produced by fire."—(*Idem*, 50, and *note*.)

The whole theory of the formation of gaseous bodies depends upon the assumption of the existence of *caloric*,—the *matter* of heat. Let this one point be granted, and every difficulty vanishes:—that which cannot be proved by the evidence of the senses, or by the aid of instruments contrived expressly to measure heat, is explained by the operation of *latent* heat. This latent or dormant heat produces exactly opposite effects; it acts in direct contradiction to the laws by which its operations are said to be governed; nevertheless, it still holds almost undisputed sway, it still serves to interpret the most anomalous phenomena; and men's minds are as completely imbued with notions of its predominating influence, as they were in the days of Stahl, with the belief that *phlogiston* existed in a fixed, solid state, in all substances termed combustible bodies,—but *latent* and dormant, till it was revealed, and brought into action by some peculiar exciting cause. Thus the doctrine of latent caloric appears to differ, so far at least, only in name, from the phlogistic theory of Stahl. I shall therefore content myself, by requesting the reader whose turn of mind may lead him to reflection and experimental inquiry, to try every phenomenon ascribed to the agency of caloric, by the established

laws of electricity, and electro-chemical agency; and then to determine, whether a fluid, whose existence and agency are undeniable, be not in every respect a more probable and efficient agent in the production of these phenomena, and especially, (since it is acknowledged that "a more intense degree of heat may be obtained by electricity, than by any other means whatever,") than *caloric*—a something—whose existence as a *material cause*, is altogether hypothetical, and which, in truth, is merely a conventional term for an *effect*, the cause of which is wholly unknown.

133. *On the chemical properties of the atmosphere.*—Lavoisier, by patient attention to a thrice-repeated experiment (each of twelve days' duration) on mercury, exposed at a boiling heat to the influence of air, in close vessels—effected the analysis of that air, and determined that 27 parts by weight, out of 100, disappeared; the mercury having gained *so much*, and undergone a complete alteration in its form and appearance; while 73 parts of a gas unfit for respiration remained unabsorbed. He re-produced these 27 parts, and restored the metallic form of the mercury; and proved that the 27 parts consisted of vital respirable air. He then mixed the two gases, so as to produce a total of 100 parts, and found that an elastic fluid, precisely similar to atmospheric air, was the result; and thus he effected what he deemed the *synthetic proof* of the composition of atmospheric air. To the air which supported light and flame, he gave the name of oxygen gas, as we have seen at No. 101; to the mephitic, or unrespirable air, he gave one of those names that it now bears; and he thus accounts for the adoption of the term. "It cannot be breathed by animals, neither will it admit of the combustion of inflammable bodies, nor of the calcination of metals. The chemical properties of the noxious portion of atmospheric air, being hitherto but little known, we have been satisfied to derive the name of its base from its known quality of killing such animals as are forced to breathe it, giving it the name of *azote*, from the Greek privative particle *a*, and *ζωη*, *vita*, life: hence, the name of *azotic gas*."—(*Elem.* chap. 3.)

Chemists have subsequently arrived at somewhat different conclusions concerning the proportions of the two prime constituents of air. Henry estimates them at 21 per cent. of oxygen gas, and 79 per cent. of azotic gas, both by measure.

Parkes agrees with Henry, in these proportions, and adds further, that by weight, the two gases are as 23 of the former to 77 of the latter. Besides these two chief constituents, atmospheric air holds in solution small portions of watery vapour, carbonic acid gas, and sometimes hydrogen and carburetted hydrogen gases. Parkes

estimates the water, or aqueous vapour, at one hundredth, and the carbonic acid at one thousandth part of the whole. Mr. Dalton's analysis gives,

Of Oxygen gas . . . . .	21
Azotic gas . . . . .	77·5
Aqueous vapour . . . . .	1·42
Carbonic acid . . . . .	·08
	<hr/>
	100·00

134. *Of the nature of azotic gas.*—Azote, or nitrogen, as it is often styled, from the circumstance of its being the base or generator of nitrous acid, is somewhat lighter than atmospheric air, 100 cubic inches, at the temperature of 60°, the barometer standing at 30 inches, weighing 30·45 grains; whereas the same measure of atmospheric air weighs 31 grains. Its specific gravity, compared with that of air, is as 980 to 1000: that of oxygen gas is 1108.—HENRY'S *Tables*.) Some idea of the properties of this gas may be collected from what has been quoted from LAVOISIER'S *Elements*; the process employed by that great man to procure it, was worthy of his patient spirit of investigation:—one much more speedy, is to mix equal weights of iron filings and sulphur, with a sufficient quantity of water, to form a paste; to put this mixture into a cup standing in a dish containing water, and then to invert over the cup, a glass jar, whose open mouth is to be immersed in the water, thus excluding all ingress of air, and securing from external influence, the process which takes place between the chemical agents enclosed. In a few days, the air in the jar will sensibly diminish, and the water will rise in proportion: finally, the oxygen gas of the air being absorbed by the agency of the mixture, the iron filings become oxidated, and the gas in the jar being reduced to three-fourths of its original volume, will be ready for the purposes of experiment.

Dr. Henry states the properties of this remaining gas, which is azote, or nitrogen, to be as follows:—

- (a.) It is lighter than air, in the proportion above mentioned.
- (b.) It is not absorbed by water.
- (c.) It immediately extinguishes a lighted candle, and all other burning substances.
- (d.) It is fatal to animals that are confined in it.
- (e.) When mixed with pure oxygen gas, in the proportion of four parts to one of the latter, a mixture will be composed resembling atmospheric air in all its properties.

With regard to its effects on vegetation, Sir Humphry Davy thus expresses himself, in his fifth Agricultural Lecture: “The

effects of azote in vegetation are not distinctly known. As it is found in some of the products of vegetation, it may be absorbed by certain plants from the atmosphere. It prevents the action of oxygen from being too energetic, and serves as a medium in which the more essential parts of the air act: nor is this circumstance unconformable to the analogy of nature; for the elements most abundant on the solid surface of the globe, are not those which are the most essential to the existence of the living beings belonging to it."

Such, then, is the substance, pretty nearly, of all that is at present known of the nature and properties of azote or nitrogen. Some few phenomena have, however, been remarked, which have led to the supposition that it is not a *simple gas*, the particles of which are kept asunder by the repulsive agency of caloric; but a compound decomposable body, consisting of a peculiar base, in union with oxygen. An experiment by Dr. Priestley, it is probable, first led to the suspicion; for it is stated, that in distilling water in earthen retorts, or through earthen tubes, at a high temperature, he found that much nitrogen had been disengaged, although he had previously freed the water from atmospheric air. Dr. Priestley mistrusted his experiments, believing that some flow or porosity in the tubes or vessels, might have admitted atmospheric air. A somewhat similar result, has, however, been since observed; for, in distilling water through glass tubes, in which a little fine clay, lime, or siliceous earth was placed, *nitrogen* gas was developed; and Sir Humphry Davy, more recently, has witnessed effects, produced by the action of *potassium* upon *ammonia*, which have led him to imagine, "that he has succeeded in decomposing nitrogen, and that he shall be able to prove it to be an *oxide of hydrogen*, containing a still *larger portion of oxygen*, than is even necessary to form water."—(PARKES'S *Rud.*) (See DR. FARADAY'S *Experiment.*)

Enough has been observed, by several chemists, to induce them to conjecture that azote, or nitrogen, is a compound and decomposable aëriform fluid; but I cannot conceive that the strongest evidences of the fact are to be found in the processes of the analytic chemist: these may tend to corroborate and add weight to it, but the volume of evidence must be sought for elsewhere,—in Nature's own vast laboratory: and it will be found, I think, in the phenomena of the decomposition of water, and of aqueous vapours, produced on, and raised from, the surface of the earth by the agency of the sun's electrizing principle, and by that of developed electricity.

135. *Evaporation from the earth's surface.*—It is probable that few have any conception of the immensity of the volume of this

aqueous vapour; I, therefore, quote the following passage from the report of one of the public lectures. “When Dr. Halley was at St. Helena, he made a variety of experiments on the evaporation of water from the surface of the sea, and found that ten square inches of water evaporated one cubic inch in twenty-four hours; or, that a surface of a square mile would evaporate daily 6914 tons. It is calculated that the Mediterranean Sea evaporates daily no less than 5280 *millions of tons*; but this quantity is much greater than is evaporated by any other body of water of equal surface, owing to its proximity to the land which surrounds it on all sides. The total average quantity of water evaporated from the whole surface of the earth, is calculated by Dr. Thompson to amount annually to 94,450 *cubic miles*.” Even in the driest seasons, when the ground was parched and appeared void of moisture, when it cracked and formed rents and fissures, it was ascertained by experiment, with a glass placed on such ground, that 1600 gallons of *water* must have evaporated from an acre of surface every twenty-four hours. Now, if one single pint of water, when it is in a state of vapour, occupies 1400 or 1500 pints, what must be the volume of vapour derived from the stupendous bulk of water that is conveyed into the atmosphere by evaporation from the entire surface of the whole globe? Of this enormous, inconceivable volume, about two-thirds are supposed to be precipitated in the form of *rain*; another small part is also supposed to be deposited as *dew*; but, admitting these suppositions to be facts, what becomes of the remainder of the vaporized water? Is it decomposed? If it be, what is the decomposing agent, and what the product? To obtain a philosophical answer to these questions, it will be requisite to pay some attention to the phenomena of vaporization.

136. *Phenomena of vapour and steam*.—If, when the air is cold or frosty, any one expel his breath forcibly, and notice the vapour produced, he will perceive no appearance of condensation;—it is the same when steam is raised from boiling water: be the temperature what it may, provided the *weather be dry*, the steam rises, expands, breaks off into irregular masses, and, after forming various convolutions, wholly disappears. Every action, every form it assumes, denotes repulsion and attenuation, instead of condensation. But if the breath be expelled, or steam projected against a pane of window-glass, the effects will be very different: if the external air be cold, condensation will take place, and small drops of water will be instantly deposited! What can be the *cause* of this remarkable condensation, produced by the intervention of a thin plate of glass? These little circumstances, of every-day occurrence, are too often passed over

without notice, yet they are subjects of the deepest interest; and frequently, if attended to, might lead to an insight into the most profound operations of nature! This condensation is usually ascribed to a difference of external temperature, and it certainly is coincident with such a difference: but as variations in temperature and in atmospheric pressure are themselves only manifestations of the active energy of those electro-chemical agencies by which the most important changes and developements are effected, the solution of the phenomenon in question must be sought for in some cause independent of heat; and the state of the atmosphere must be considered. If it be dry, and the pressure considerable, the water deposited on the glass will be speedily taken up, and entirely disappear, whatever may be the degree of external cold, provided it do not freeze the water on the pane; but if the air be cold and damp, and the pressure in a diminished state, the water will remain on the glass for a considerable time. The experiment may be varied, and then afford other interesting subjects for reflection. If the fume from tobacco, ignited in a common pipe, be propelled against a pane of glass, by holding the bowl diagonally, with its edge in contact with the pane, and blowing forcibly through the pipe, watery particles will be deposited in an extended figure; and if the external air be cold and damp, the carbonaceous matter, or smoke, will be held as if rooted to the deposited water, and will terminate in a kind of point, waving about in various directions for four or five seconds, with a motion not dissimilar to that occasionally observed in the jagged horizontal edges of electrized clouds. The duration of these singular appearances depends altogether upon the state of the air; if it be dense and dry, they can scarcely be produced, or, if they be, they vanish almost immediately. The production of vapour is always attended with electricity; or, rather, it is a phenomenon of electro-chemical development: when, therefore, vapour is propelled against glass, it excites that glass, and this excitation produces induction and attraction; consequently, the vapour is again reduced to the form of water, and held on the glass till the atmosphere again decomposes it: therefore, the deposition of water on an excited surface, and its converse, the dispersion of vapour throughout the atmosphere, may be viewed as synthetical and analytical phenomena\* of electro-chemical agency.

137. *Of the vapours of the atmosphere.*—The inquiry into their ascent and appropriation is one of exceeding interest. The general fact of the ascent of a vast volume of aqueous vapour is admitted on all hands; it is not less true, that vapour rises, or is taken up, by

\* The terms *analysis* and *synthesis* have been explained at No. 96.

the influence of some cause wholly independent of the agency of heat. Nothing can be more remarkable or striking than the sudden absorption and disappearance of frosty rime. During the month of January (1829)\*, the trees, bushes, and herbage were, at two distinct periods, completely enveloped with frosty spiculæ; every blade of grass, every twig, was studded so thickly with masses of snow-white crystals, as to be enlarged to double its usual dimensions. A mist, or stratus, had, at an early hour, overspread the whole surface of the ground, and at the same time, the temperature was many degrees below the freezing point; but when this mist was drawn up, the atmosphere for several hours remained transparent and cloudless. On the first occasion, the sun shone out clear and with power; but still the frost was severe, and the sun's rays produced but a very partial effect in *dissolving* the rime; *it was, however, taken up silently and completely*. On the recurrence of the phenomena on the 25th, I noted down the most striking appearances. There was no wind; scarcely *any air* was stirring; there was no material difference in temperature; yet, without thawing, without any visible solution, the whole of the rime vanished, every particle disappeared; it was taken up in a very short period of time, about the hour of noon; the transparency of the atmosphere was lost, and clouds formed. The temperature about eight o'clock A.M. had been  $16^{\circ}$ , and at two or three o'clock it was  $24^{\circ}$ , at night  $30^{\circ}$ , and on the following day above  $40^{\circ}$ , and rain fell. The advocates for the doctrine of *latent heat*, maintain, as one of their grand axioms, that when solids or fluids become *gases*, latent heat is absorbed, and *cold* is produced. Millions of cubic feet of crystallized water, as it is called, were, during this phenomenon of absorption, converted into an aerial fluid, and the thermometer rose in the same day about  $14^{\circ}$ ! There are other facts equally illustrative of the fallacy of the axiom, that "caloric in a latent state exists in all substances, and that whenever substances become more condensed, *heat* is evolved; when they expand, *cold* is produced!" Snow is observed to be drawn up into the atmosphere much in the same way as hoar frost and dew are; it undergoes no apparent change; it does not appear to be dissolved by heat, but its substance is gradually diminished, even during a frost, and at length many portions of the surface of the ground become divested of their covering. These are phenomena of frequent occurrence, and they tend to prove that vapours are attracted and propelled into the atmosphere. It will now be necessary to inquire in what *state* these vapours exist therein; whether it be that of simple

\* This period is mentioned, because the phenomena were particularly noticed by me; they are, however, of no unusual occurrence.

mixture, wherein they remain unaltered in their chemical properties, although infinitely attenuated; or whether they become chemically united with the gases of the atmosphere by a new electro-chemical arrangement of their elements. That they should exist in the former state, one of simple mixture, is incompatible with the phenomena of *pressure*; for, as watery vapours, really existing as such, are lighter than atmospheric air, they would, in proportion as they were diffused through that air, render it specifically lighter. But if the watery vapours become decomposed, and their elements enter into new arrangements, identical with those of atmospheric air, then the conclusion is inevitable, that *air is produced from decomposed water*; and consequently, that it is compounded of elements which determine it to be a peculiar *oxide of hydrogen*.

138. *Of the chemical union of the vapours of the atmosphere.*—If we attentively consider the various alternations of the weather, we may possibly acquire some clear and definite ideas of the nature of an union, the phenomena of which have, heretofore, been involved in so much perplexing mystery. One or other of the dry summers of 1818, 1825, 1826, and 1835, must be in the recollection of almost every person of observation. During a great part of these summers, the prevailing character of the atmosphere was that of almost vapourless transparency: the temperature ranged from  $76^{\circ}$  to  $86^{\circ}$ , and occasionally to a higher degree. At such periods evaporation must have been at its maximum; millions of tons of water must daily have been conveyed into the atmosphere, and yet its transparency was not diminished; and so far from clouds or rain resulting from this measureless absorption of vapour, the *dew* was precipitated, even during the clearest nights, in extremely diminished quantity. What, then, had become of the volume of vapours? Had it passed into a state of uniform blending, or equal diffusion, through the agency of that peculiar principle, by which, according to Mr. Dalton's theory, *each gas becomes a vacuum to every other gas*? or had it been carried by winds to other climates, and *there* deposited as rain? Is it not infinitely more probable that the volume of vapour was converted by electric divellent attraction, and a consequent new arrangement of its elements, into atmospheric air, thus adding to the bulk, and increasing the weight of the aerial column? Is not every well-observed phenomenon—the rapid drying of all moistened substances—the dissipation of clouds without wind—the absolute clearness of the nights—the decreased deposition of dew;—are not all these, and other corresponding facts, in exact accordance with the theory? Can any other appropriation of the vapours account for all the multifarious meteoric transmutations? But what should induce these

transmutations? What should set limits to the operation of the principle of absorption, and thus cause a return of those watery vapours? The only answer that can be returned, is, that by an immutable law of creation a change is effected; during the progress of which, the power of repulsion being diminished, the buoyancy and transparency of the atmosphere decrease, a *cirrus* forms, denser clouds assemble, and rain is precipitated. All these mutations are accompanied by a variety of coincidences, which unerringly point out the agency of electro-magnetic affinities. The barometer falls, humidity becomes perceptible, the animal spirits are depressed, a listlessness prevails, and occasionally, the head is affected with a sensation amounting almost to giddiness: the brute creation participates in the change; and many animals evince signs of uneasiness, or, at least, of being peculiarly affected. These are facts which afford evidence infinitely more conclusive, of the real nature and origin of atmospheric air, than any that can be found in those experiments of the analytic chemist which have hitherto been announced.

139. *Compressibility of atmospheric air.*—One of the most remarkable experiments that has ever been performed, and which bears particularly upon the question concerning the nature and properties of atmospheric air, was exhibited in the presence of two of the most eminent philosophers of the day, by Mr. Perkins. It is stated, that he placed dry air, in an inverted tube, over mercury; and, by means of an apparatus, termed a *piezometer*, succeeded in compressing that air into a *liquid*. The phenomena are thus reported:—"At a pressure of 500 atmospheres, the air began to disappear, evidently by liquefaction; at 600 atmospheres, the mercury was sustained one-eighth of its volume up the tube; at 800, one-third; at 1000, two-thirds; and at 1200, (*i. e.* when a pressure equal to about 15,000 pounds on the square inch was applied,) it was sustained three-fourths, when a *beautiful transparent liquid appeared on the surface of the mercury*, in quantity about a two-thousandth part of the original bulk of the air. Dr. Wollaston and Sir Humphry Davy were present at some of these experiments, and expressed themselves satisfied of their accuracy." Such is the substance of a fact detailed at two public lectures; and upon one of the occasions, the lecturer added, "that if the liquid had been subjected to a *freezing* mixture, and had lost another portion of its caloric, it might have assumed the solid form of *ice*." If the details of this experiment have been correctly recorded, and if the result obtained were really effected by the pressure employed, then the question, whether air be, or be not, a permanently elastic fluid,—one, incapable of being compressed into a liquid, is for ever decided! But what was

the nature of the liquid obtained by Mr. Perkins? It would be well to repeat the experiment with the utmost degree of accuracy, and to subject the liquid to the action of a powerful freezing mixture. If *ice* were produced, the inquiry need not be pressed much further: that which should furnish *ice* could not be of a nature widely removed from that of water; and the elements of water require no further elucidation.

140. *Phenomena of atmospheric pressure.*—It has been stated at No. 131, that the atmosphere is supposed to extend to the altitude of about forty-five miles: if the statement be correct, a column of that length presses upon all bodies upon the surface of the earth *equally in every direction*, and with a force or weight amounting to nearly fifteen pounds upon every square inch. Variations in atmospheric pressure are continually taking place, and an instrument called a barometer, from two Greek words *βαρος* (baros), weight, and *μετρον* (metron), measure, has been constructed to measure or determine these variations. The general annual average height of the mercury in the barometer, calculated from the monthly averages given in the *British Almanac*, is about twenty-nine inches, eighty-eight cents; or, in plainer terms, the weight of the atmosphere sustains a perpendicular column of mercury to the elevation of thirty inches, less twelve hundredth-parts of an inch, on the average of the whole year. The greatest degree of pressure appears to be exerted during the months of February and June; and the least, during the three latter months of the year. The variations in the pressure of the atmosphere appear to me to furnish additional evidences of the aqueous origin of atmospheric air; but before I adduce these evidences, I shall quote a passage or two from the *Companion to the British Almanac*, for 1828, wherein the subject of pressure is investigated.

“It may be asked in what way the varying weight of the atmosphere is connected with the changes of the weather, and what produces this variation in weight? These are questions which have long puzzled philosophers; and many erroneous solutions have been given of the problem. By some, the increase of weight has been supposed to proceed from the *quantity of water dissolved in the air*; *this is, however, refuted by the simple fact, that, when the barometer stands highest, the air is most dry, and, on the contrary, rain generally occurs when the atmosphere is light.* Others, again, have attributed the phenomenon to a centrifugal force, communicated to the wind by this rotatory motion of the earth. The question is certainly very difficult and complicated.”—Page 17, *Brit. Alman.*

*The writer proceeds at some length to demonstrate, that owing*

to the unequal distribution of heat over the surface of the earth, the ærial fluid must be perpetually circulating in opposite currents between the colder and the hotter points: that so long as these currents balance one another, or, “as long as an equal quantity of air is brought by one stream to the base of the perpendicular column, to what is carried away by the other from its summit, so long will the combined weight be unchanged; but should any cause check the course of one, without at the same time impeding that of the other, the balance will be destroyed, and the barometer, by its rise or fall, will mark the amount of the difference.” At page 18, he says, “We need not be at a loss to discover a cause quite competent to produce the unequal effects upon the currents of the atmosphere, contemplated above. *Mingled with the atmosphere of permanent gases, an invisible atmosphere of steam is constantly rising from the surface of the globe, varying in force with the temperature of the waters from which it emanates. This vapour rises unchanged, till, in the gradually decreasing temperature of the air, it arrives at the upper regions at a degree of cold by which it is condensed; and becoming visible, assumes the form of clouds. In the act of condensation, however, an immense quantity of heat is set free, which was previously combined with the steam in the latent form, and this, acting upon the surrounding air, expands it, and gives an additional, but unequal impulse, to the current in which the phenomena occur. The clouds, again, are themselves subject to evaporation, and the vapour is carried to still higher regions, where another precipitation takes place; till at length large masses of the atmosphere have the natural progression of their temperature changed, and their currents altered, or perhaps reversed. The increased temperature of the air is accompanied by a great increase in the force and quantity of the steam, the final precipitation of which takes place in the form of rain, and the atmosphere returns to its mean state through the influence of winds which restore the original balance. The order of the phenomena corresponds with the facts, that the barometer is most steady when the weather is clear, and fluctuates most with clouds and rain; and also explains the reason why, in the greater disturbances of the ærial ocean, local deficiencies of the elastic fluid are restored by winds, whose force is nearly proportioned to the vacuum which they supply.*”

Does the reader feel perfectly convinced of the soundness of the foregoing theory? Does it carry with it its own internal evidence of being founded upon philosophic truth? Minds, no doubt, are differently constituted, and there is no accounting for a difference of views and opinions. To me it appears, that the writer has lost sight

of those simple facts which scarcely could have failed to elucidate the whole of the phenomena of pressure, had they not been hampered and involved with the perplexing and contradictory doctrine of *latent heat*. I have noted those passages in italics, which appear to contain all that is essential; and by referring to them, shall endeavour to prove, that they are equally decisive of the aqueous origin of atmospheric air, as of the real causes of variation in atmospheric pressure.

“The increase of weight,” argues the writer, “cannot proceed from the quantity of water dissolved in the air, because, when the barometer stands highest, the air is most heavy,” and *vice versâ*. This is exactly the fact that I have been urging, as *demonstrating the certainty of the conversion of vapours into atmospheric air*; seeing that when the air is dry, evaporation is at its maximum. “Mingled with the atmosphere of permanent gases, an invisible atmosphere of steam is constantly rising from the surface of the globe.” This is a general fact, but what ought to be the result? Steam and vapour are *lighter* than air, (No. 137,) and *clouds float* in it, as is familiarly known to every observer. This column, this *atmosphere* of steam, then, must do one of two things; it must either, and invariably too, render the atmosphere specifically lighter, just in the proportion as it becomes mixed with it, as ardent spirits when mixed with water decrease the specific gravity of that fluid; or it must enter into union, and become homogeneous *with* the atmospheric gases; and this union can be effected only by a specific electro-chemical arrangement of its elements. “*The order of the phenomena*,” it is added, “*corresponds with the facts*.”—It does indeed! “The barometer *is* most steady when the weather is clear, and *fluctuates* most with clouds and rain.” In proportion as the vapour is converted into air, so is the weight of the column of pressure augmented: and in serene and hot weather, when the quantity evaporated is prodigious, if the barometric column be at thirty inches, the atmospheric pressure is about fifteen pounds avoirdupois on the square inch; but, as a provision is made for a reproduction of a certain portion of the evaporated fluids to be precipitated in the form of rain, when those electrical agencies are exerted which reproduce aqueous vapours, a decomposition, a new arrangement takes place, and *air* becoming charged with a *lighter fluid*, the pressure on the column becomes proportionably lessened, and the barometer falls.

The total range of this instrument rarely exceeds three inches: that is, the mercury seldom falls below twenty-eight inches, or rises quite so high as thirty-one inches, and the difference in pressure may be estimated, pretty nearly, by allowing one pound for every two

inches of the column. The phenomena of the rise and fall of the barometer may, therefore, be explained in a very few words. The *rise* is occasioned by an increase of weight in the atmospheric column, which increase *can*, it should appear, be produced by no other natural means, than by the appropriation of vapours ascending from the earth's surface. The *fall* is the result of decreased pressure, occasioned by the reproduction of aqueous vapours; which being diffused throughout the volume of air, render it specifically lighter.

If this re-production take place to a considerable extent, and be effected suddenly, the phenomenon of a storm of wind will probably be induced, and that in a way which will tend to confirm an axiom of Dr. Franklin:—"That storms originate in the places towards which they blow!" In whatever situation, therefore, the decomposition and change of pressure take place, whether they be effected silently and slowly, or suddenly and with violence, "*the local deficiencies of the elastic fluid are restored by winds, whose force is nearly proportioned to the vacuum which they supply.*"

141. *Atmospheric Theory.*—After attentively viewing the astonishing and most beautiful phenomena of Nature, and comparing them with the results of some analytic chemical experiments, I cannot but consider it as proved almost to a demonstration, that *the atmosphere was originally formed out of, and is daily renewed by, vapours, raised from the surface of the earth and waters, by the agency of solar induction and decomposition;—that it is, therefore, composed of the elements of water, in a new and peculiar arrangement, effected by the energy of specific electro-chemical agencies; and consists of two gases, NITROGEN and OXYGEN; (the former being a neutral oxide of hydrogen,) existing in the proportions of about seventy-seven parts of the former, to twenty-three of the latter, both by weight.*

The nature of this union may be considered as analogous to that by which an excess of an alkali, or acid, is attached to a chemical neutral salt; of which a familiar instance may be found in the common cream of tartar, otherwise termed, super, or bi-tartrate of potass. This excess of oxygen gas may be separated from the atmosphere, by the action of several chemical re-agents, and by some processes of combustion; and when separated, it appears that the neutral oxide of hydrogen exerts an electric energy, different from that of the detached portion of oxygen; the former being *positive* and the latter *negative*; whence it may be inferred, that the nature of their union is electric, and that they mutually attract each other.

142. *The atmospheric theory* now advocated, will not only explain the nature of *nitrogen* gas, but it will tend to account for all the phenomena of thunder and lightning, and that too without impugn-

ing Mr. Dalton's theory of each gas being a vacuum to every other gas. That theory, in point of fact, is sustained and interpreted by the aqueous hypothesis; for the latter includes the principle of the universal diffusion and unceasing appropriation of the vapours into one homogeneous volume. As far as respects the phenomena of thunder-storms, the electric developements appear to be amply sufficient to account for the lightning, and the elements of water being also at hand, no one need be at a loss to discover the causes of those violent detonations which ever must result from sudden combustion of large volumes of the two gases. Finally, the theory implies, and, indeed, is founded upon the indestructibility of matter, and that ceaseless interchange of agencies, by which Nature effects the renewal and restoration of all her productions. I cannot conclude the subject more appropriately than by copying a beautiful note from the 336th page of PARKES'S *Rudiments*.

“It was said of old, that the Creator *weighed* the dust and *measured* the water, when he made the world. The first quantity is here still, and though man can gather and scatter, move, mix, and unmix, yet he can destroy nothing. The putrefaction of one thing is a preparation for the being, and the bloom, and the beauty of another. Something gathers up all fragments, and nothing is lost.”

143. The length of the present section precludes the consideration of the phenomenon of the *deu*; that must therefore be referred to the section upon Light and Heat, MAY.

It only remains to give a succinct description of the scientific arrangements of the CLOUDS, by Mr. Luke Howard. I shall not attempt to anglicise his nomenclature, by introducing a set of local provincial terms; but as I conceive some advantage may result from placing the *derivation* of each Latin term in conjunction with that term, I shall do this to the best of my ability, without adding one word by way of comment; what follows therefore (excepting the derivation), is a verbatim extract from LONDON'S *Enc. of Gard.*, p. 257: the numbers refer to the paragraphs of that work.

144. “*Simple modifications* are thus named and described:—*Cirrus*:” (*Cirrus*, from *Kippos*, a lock of hair, a tuft or crest of feathers,) “parallel flexuous, or diverging fibres, extensible in any or all directions. The *cirrus* appears to have the least density, the greatest elevation, the greatest variety of extent and direction, and to appear earliest in serene weather, being indicated by a few threads pencilled on the sky. Before storms they appear lower and denser, and usually in the quarter opposite to that from which the storm arises. Steady high winds are also preceded and attended by

cirrous streaks, running quite across the sky in the direction they blow in." (Nos. 1226—1239.)

(2.) "*Cumulus*:" (*Cumulus*, from χύω, to *heap up*, or χῶμα, a *mound*;) "convex or conical heaps, increasing upwards from a horizontal base. The *cumulus* has the densest structure, is formed in the lower atmosphere, and moves along with the current next the earth. A small irregular spot first appears, and is, as it were, the nucleus on which they increase. The lower surface continues irregularly plane, while the upper rises into conical or hemispherical heaps; which may afterwards continue long, nearly of the same bulk, or rapidly rise into mountains. They will begin in fair weather to form some hours after sunrise, arrive at their maximum in the hottest part of the afternoon, then go on diminishing, and totally disperse about sunset. Previous to rain, the *cumulus* increases rapidly, appears lower in the atmosphere, and with its surface full of loose fleeces or protuberances. The formation of large cumuli to leeward in a strong wind, indicates the approach of a calm with rain. When they do not disappear or subside about sunset, but continue to rise, thunder is to be expected in the night." (1236—1240.)

(3.) "*Stratus*:" (*Stratus*, from στράω or στροάω,—*spread abroad—lying or resting upon*;) "a widely-extended, continuous, horizontal sheet, increasing from below. The *stratus* has a mean density, and is the lowest of clouds, its inferior surface commonly resting on the earth in water. This is properly the cloud of night, appearing after sunset. It comprehends all those creeping mists which in calm weather ascend in spreading sheets (like an inundation of water) from the bottoms of valleys, and the surfaces of lakes and rivers. On the return of the sun, the level surface of this cloud begins to put on the appearance of *cumulus*, the whole at the same time separating from the ground. The continuity is next destroyed, and the cloud ascends and evaporates, or passes off with the appearance of nascent *cumulus*. This has long been experienced as a prognostic of fair weather." (1236—1241.)

145. *Intermediate modifications* are (4), "*Cirro-cumulus*" (from 1 & 2) "small, well-defined, roundish masses, in close horizontal arrangement."

(5.) "*Cirro-stratus*," (from 1 & 3), "horizontal, or slightly inclined masses, attenuated towards a part or the whole of their circumference, bent downward or undulated, separate, or in groups consisting of small clouds having these characters." 1237.)

146. "*Compound modifications* are (6), *Cumulo-stratus*, (from 2 & 3,) a twain-cloud; the cirro-stratus blended with the *cumulus*,

and either appearing intermixed with the heaps of the latter, or superadding a wide-spread structure to its base."

(7.) "*Cumulo-cirro-stratus*," (from 2. 1. 3.) "vel *Nimbus*," (*nimbus*, possibly from *νέμιμαι*,—*a shower*); "the rain-cloud, a cloud or system of clouds from which rain is falling. It is a horizontal sheet, above which the cirrus spreads, while the cumulus enters it laterally and from beneath; (8.) the '*Fall cloud*' resting apparently on the surface of the ground." (1238).

147. *Transitions of forms.* The cirrus having continued for some time increasing or stationary, usually passes either to the cirro-cumulus or the cirro-stratus, at the same time descending to a lower station in the atmosphere. This modification forms a very beautiful sky, and is frequently in summer an attendant on warm and dry weather. The cirro-stratus, when seen in the distance, frequently gives the idea of shoals of fish. It precedes wind and rain; is seen in the intervals of storms; and sometimes alternates with the cirro-cumulus in the same cloud, when the different evolutions form a curious spectacle. A judgment may be formed of the weather likely to ensue, by observing which modification prevails at last. The solar and lunar halos," (from *Αλων*, *a bright circle round the sun or moon*,) "as well as the *parhelion* and *parselene*, (mock sun and mock moon,) prognostics of foul weather, are occasioned by this cloud. The cumulo-stratus precedes, and the nimbus accompanies rain." (1242.)

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In this section, now brought to a close, and in the three preceding sections, I have endeavoured to investigate somewhat closely the four substances which, by the ancient chemists, were considered as the undecomposable *elements* of all other bodies. I have endeavoured, also, to show that the *earth* is the matrix and laboratory wherein the young plant is produced, its food prepared, and its roots finally established; that *fire*, pure elementary fire, the great agent of induction, attraction, cohesion, and possibly, of gravitation, is developed within the surface of the earth by the electrizing principle of the sun's rays; by which principle also, *water*, the grand secondary agent, is decomposed, and, by its decomposition, leads to the most mighty phenomena: and lastly, that *air*, the vital support of all beings that breathe or inhale, is itself derived from the decomposition of water. In these discussions, I have endeavoured to establish the position laid down at No. 67, that "chemical action of every kind is effected by electric agency; and that in every case where electrical phenomena are discerned, chemical affinities are

either induced or regulated. In this view of the subject, it has been my aim to render it clear, that there are specific electric modifications throughout nature, which produce specific results; that the grand masses of accumulated electricity are probably destined to regulate the grander inductions; but that *all inductions*, and *all phenomena* whatever, are to be referred to the operations of that one grand principle, the *sun*, the source of, and prime operative agent in all the phenomena of the material world.

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## SECTION II.

### PART I.

#### NATURAL HISTORY AND CULTIVATION OF ESCULENT VEGETABLES.

ASPARAGUS:—*Asparagus Officinalis*, (*Asphodéleæ*.) of the Class vi.  
Order i. *Hexandria Monogynia*, of Linnæus.

148. *The Asparagus* is a native of the British Isles, its essential general character, according to SMITH'S *Flora*, is an inferior *corolla*, of six deep segments, permanent:—a *berry* of three cells:—stigmata three. This species has an herbaceous annual stem; round, without prickles, much branched; leaves very minute, tufted, bright green, bristle-shaped; berry, scarlet. The root is perennial, with long fleshy fibres; the crown is densely scaly, from which proceed numerous heads, which constitute the part that is eaten. The native, wild asparagus, according to Dr. Smith, grows on the sea-coast near Weymouth; in sandy places on the west and south coasts, and near Edinburgh; but otherwise, rarely in Scotland.

According to LONDON'S *Encyclopædia* (No. 3856), many of the steppes in the south of Russia and Poland are covered with this plant, which is there eaten by the horses and oxen as grass. In its native state, it is so dwarfish, even when in flower, that none but a botanist would consider it as the same species with our cultivated plant. Neill says, that "asparagus was a favourite of the Romans; and they seem to have possessed a very strong-growing variety, as Pliny mentions, that about Ravenna, three shoots would weigh a pound; with us, six of the largest would be required. It is much praised by Cato, and as he enlarges much on the mode of culture, it seems probable that the plant had but newly come into use. In this country, Dutch asparagus was preferred in the end of the seven-

teenth century; and this variety is still distinguished for affording the thickest stems. Some say there are two varieties, the red-topped and the green-topped, others doubt the fact; there is, certainly, a difference in point of colour to be observed, but this may depend upon modes of culture and varieties of soil.

In the neighbourhood of London, vast quantities are grown for the public supply, and some of the bundles have a tinge of red, not usually discernible in the asparagus of private gardens. This delicious vegetable is sold at a very high price, sometimes at five shillings the hundred; and hence it is a source of great profit to those who grow it in extensive plantations of from fifty, to one hundred acres in extent.

149. *Propagation.* Asparagus is a perfectly hardy plant; it invariably produces ripe seeds every autumn, and from these it is raised, although it appears that the roots might be divided like those of some other fibro-tuberous rooted plants. The seeds should be gathered when they are perfectly mature, and from the strongest and finest shoots. A *pint* is sufficient to sow a bed thirty feet long, by five feet wide: that is, when the bed is intended to be a permanent plantation, raised originally from seed, not to be *transplanted*.

*In forming new plantations*, many prefer to purchase roots of one or two years old, by which so much time is saved. A bed four and a half or five feet broad, by thirty feet long, comprising four rows, each one foot apart from the adjoining row, will require 160 plants, provided they be set nine inches asunder in the rows.

150. *Soil and preparation.* "Asparagus-ground should be light, yet rich; a sandy loam, well mixed with rotten dung or sea-weed, is accounted preferable to any. The soil should not be less than two and a half feet deep; and before planting a bed, it is considered good practice to trench it over to that depth, burying plenty of dung in the bottom, as no more can be applied there for eight or ten years. It can scarcely therefore be too well dunged; besides, although the plant naturally grows in poor sandy soil, it is found that the sweetness and tenderness of the shoots depend very much on the rapidity of the growth, and this is promoted by the richness of the soil. Damp ground, or a wet sub-soil are not fit for asparagus: indeed, the French consider wetness as so prejudicial to this plant, that they raise their asparagus-beds about a foot above the alleys, in order to throw off the rain." (LOUDON, 3864, from NEILL.)

Judd says, "Prepare a piece of good land, unincumbered with trees, and that lies well for the sun; give it a good dressing of well-reduced horse-dung, from six to ten inches thick, all regularly spread

over the surface; then proceed with the trenching (if the soil will admit,) two feet deep: after this first trenching, it should lie about a fortnight or three weeks, and then be turned back again, and then, again, in the same space of time; by this process the dung and mould would become well incorporated, it may then be laid in small ridges till the time of planting. This work should all be performed in the best weather the winter will afford; that is, not while it rains, or snow is lying on the ground, as it would tend to make the land heavy and sour: all this is to be particularly attended to, as the preparation of the soil is of more consequence than all the management afterwards. At the time of planting, I always spread over the ground another thin coat of very rotten dung, and point it in half a spade deep, making my beds three feet wide only, with two feet of alleys, so that three rows of grass, one foot apart, are all I plant on each bed. I find this to be the best method, as by this plan there is not the least trouble in gathering; whereas you are obliged to set a foot on one of the wide beds before you can get at all the grass, to the great injury of the bed and the buds under the surface."

Dr. Macculloch thus describes the method of preparing a bed as practised in France. "A pit the size of the intended plantation is dug five feet in depth, and the mould which is taken from it must be sifted, taking care to reject all stones, even as low in size as a filbert-nut; the best parts of the mould must then be laid aside for making up the beds. The materials of the bed are then to be laid in the following proportions and order:—Six inches of common dung-hill manure, eight inches of turf, six inches of dung, as before, six inches of sifted earth, eight inches of turf, six inches of very rotten dung, and eight inches of the best earth. The last layer of earth must then be well mixed with the last of dung. The compartment must now be divided into beds five feet wide, by paths constructed of turf, two feet in breadth, and one foot in thickness." —(From *Caled. Mem.* vol. ii.)

M'Phael considers a deep mellow loam, of a brownish colour, (of course containing a considerable portion of *per-oxide of iron*,) rather of a sandy than binding nature, as most propitious to the growth of asparagus. He says—"In the course of the autumn or winter, before planting, let plenty of manure be laid on the ground; seven or eight inches thick is not too much; it may be rotten dung alone, or a mixture of dung and vegetable mould. Take an opening out at one end of the ground, three feet six inches deep, and three feet in width, and lay it down at the opposite end; then begin and trench the ground, which should not be trenched in the common

way, but it ought to be turned over, and mixed in the manner that a dunghill is mixed, or as new and old tan are mixed in a pit for the pine-apple; the labourers will, therefore, have to stand and work in the bottom of the trench, and they should chop down the dung and earth together, mixing them well as they proceed; and if there is time in frosty weather in winter, it would do it good to give it a second turning." (*Gard. Rem.* March.)

151. *Methods of Planting.*—"When the asparagus is about to be planted, and if from the nature of the soil it appear not to be rich enough, put another layer of dung upon it, and dig it in as deep as the spade will turn it. The ground being in readiness, divide it into beds four feet wide, with alleys three feet wide between the beds. Plant four rows of roots in each bed, eight inches, row from row, and about the same distance plant from plant. Let the plants be fine young ones of the former year, from seed. Stretch your line lengthways, beginning at the middle of the bed, and with a spade cut out a trench, close to the line, about six or eight inches deep; and when one trench is opened, plant it before you open another, proceeding in this way, till the whole is finished. Keep the plants well watered in dry weather, and the beds perfectly free from weeds at all times. If, instead of planting the roots, the seeds of asparagus are sown in the beds, which, perhaps, is the best method, draw drills, the same distance as is above directed for the plants, four inches deep; sow the seeds in them, and when they are out of danger, thin them, leaving them about five or six inches plant from plant. Keep the plants clear of weeds, and water the plants when they require it."—(*Idem.* March.)

*Nicol* deems it to be a matter of much importance, that, in transplanting, great care should be taken to lift out the roots without disturbing or injuring them to any considerable extent, and to avoid leaving them exposed to the air as much as possible. If this be really the case, it is obvious that it will always be best to sow the seeds at once where they are to remain; but if the chief object be to save time, and to cut asparagus as speedily as possible, then two years old plants should be purchased of a respectable gardener, and planted according to one or other of the directions now given. In these, *Abercrombie* does not differ materially from *M'Phael*; he, however, plants at nine inches apart in the rows, and places the rows one foot asunder, and the crowns of the plants two inches below the surface of the ground; the beds are then to be raked neatly, and made perfectly level, and the edges to be cut even by the line, the alleys being three feet wide between the beds.

"*Judd* strains the line, and cuts down a trench sloping, in the

usual way of planting box, and making choice of all the finest plants, puts them one foot apart, and one inch and a half below the surface. This done, he lets the alleys and beds lie level till autumn, and then digs out the alleys deep enough to get from four to six inches of mould all over the bed; over this he lays a good coat of rotten dung, and fills the alleys with long dung." (*Ency. of Gard.* 3874.)

"In France, (as we have seen at No. 150,) they plant in beds five feet wide, separated by paths constructed of turf two feet in breadth, and one foot in thickness. The plants are placed 18 inches asunder, spreading out the roots as wide as possible in the form of an umbrella, and keeping the crown an inch and a half under ground. A pin is put to each plant, as a mark; and as soon as the earth is settled and dry, a spadeful of fine sand is thrown over each pin in the form of a mole-hill."

W. R. Grayson, who has obtained two prizes from the Horticultural Society, for a variety which he styles his "New," or *Giant asparagus*, gives the following concise directions for planting the roots:—"If your ground is stiff and unpleasant to work, get some milder earth to mix with it, and a very large cart-load of rotten dung, to about every ten feet square, trench it two spit deep, and loosen the bottom; let the dung and earth be well mixed together. When your land is fit for planting, draw your drills six inches deep, sixteen inches from the first row to the second, that will form a bed, and ten inches between each plant in the row. Do not raise your beds till they have been planted one year; then put on about four inches of mould out of the alleys, and cut till the 10th of May. If you keep them well manured, they may last for twenty years, *but never cut longer than the 4th of June*. Let them be eight feet in the clear from bed to bed, so that you may crop between, and lose no land."

These directions, simple, and little elucidatory as they are, contain, nevertheless, the essentials of good planting: no one, in forming a plantation of asparagus, can do better than to excavate, or trench the entire plot to the depth of two feet, incorporating a great quantity of the pure turf of light, unctuous loam, from a sheep-pasture, with an equal portion of dung and leaves from linings of pits, half reduced. Beds so prepared in autumn or winter, can be planted in single rows, by Grayson's scale, and the intermediate crops, which may rotate between cabbages, young short-haulmed potatoes, broccoli, strawberries for one year, and celery, liberally manured, will clear the ground of fecal exudation, and prevent what is termed *exhaustion*.

152. *Subsequent Culture*.—Abercrombie observes, that the plants

will rise in April or May; they are then to be kept clear from weeds during the succeeding summer. "In autumn, when the stalks decay, cut them down, and clear away all weeds into the alleys; then by line and spade, mark out the width of the alleys, and lightly dig them, casting some earth evenly over the beds two inches thick, digging in the weeds into the bottom of the alleys; and this is all that need be done till next March or April, when, let the beds be deeply hoed, and raked even, and the buds will soon appear." He directs the whole growth of this second year to be still left untouched, and that the beds be treated in the next October, exactly as they were in the autumn of the first year. In the April following, that is, the third year after planting, the beds are to be dugged with the proper asparagus three-pronged fork, loosening the soil near the crown of the roots; they are then to be raked to a smooth and level surface."

M'Phael says, "About the latter end of the month (October), you should cut down the stalks of asparagus, and carry them away; hoe the beds, rake off the weeds, then lay a layer of rotten dung on the beds, and dig as much earth out of the alleys as will cover the dung about three inches deep. I have seen asparagus beds, which, to my knowledge, have been in bearing upwards of twenty years, and continued to produce plentiful crops of fine asparagus; and I have had asparagus cut sixteen years, from beds of my own planting, and they continue to produce as large crops of fine grass, as they did after they had been cut from eight to ten years." (*Gard. Rem.* October.)

Judd begins to cut the *third* season, but not generally; he does not in the second season repeat the operation of digging out the alleys, but lays on a good coat of dung three inches thick, and forks it evenly into the beds and alleys, and so on every season after, "never digging out the alleys any more, as it is known the asparagus plant forms a fresh crown every season, and sometimes it happens that in a few years the crown will increase almost into the alley, so that by digging out this, you must inevitably spoil that plant."

Abercrombie, on the contrary, cuts the edges of the beds full and straight, and digs the alleys to the depth of a moderate spade, leveling the bottoms, and thus leaves them all the winter.

The *French* cover in autumn with six inches of dung and four inches of sand, and in performing this operation, as well as every other, great care is taken not to tread on the beds, so as to ~~condense~~ the earth. In planting and cutting, a plank is always used to tread on; and the turf divisions of the beds, which are intended to prevent the condensation of the earth below, in consequence of walking among the beds, are removed every three years."

153. *Spring dressing of the bearing beds.*—A bed of asparagus should be in a tolerably productive state in three years after its formation from *plants*, or in four years after sowing the *seeds*; the regular spring dressing consists of digging the beds with a fork of three or four short prongs, to loosen and give air, to the depth of a few inches below the surface of the ground. This operation is termed *forking the beds*. Towards the close of March, or early in April at the latest, dig the beds, holding the fork in a slanting direction, and using the utmost caution to avoid wounding and rending the crowns and young advancing shoots. Lift the soil, turn it over, and work it about with the fork, to break the lumps: this digging will tend to promote the chemical agencies by admitting the air, and presenting new portions of the soil to its influence; it will, moreover, give freedom to the plant, and facilitate its emerging from the ground. After forking, rake the beds even, and draw off the unbroken clods into the alleys, where there are such; then dress the edges by the line, cutting them in a rather slanting direction, broader at the base, to prevent, as much as possible, the crumbling down of the upper edges, which would render them unsightly. The asparagus will, in the third and all subsequent seasons, generally rise strong, and fit for cutting, soon after the middle of April. In Austria, we are told, that it is a practice, with a view to blanch asparagus, and to give as much length and tenderness as possible, to insert, *over each stem* intended to be gathered, “as soon as it shoots above ground, a wooden tube or pipe, eighteen inches high, and one in diameter.”

154. *Of the hardiness of the asparagus plant*, further proof is given in No. 3856 of LONDON'S *Encyc.* from the *Edin. Encyc.* art. *Hort.*—“In a garden formed at Dunbar, in the beginning of the eighteenth century, by Provost Fall, (a name well-known in the mercantile world,) asparagus was for many years cultivated with uncommon success. The variety used was the red-topped, and it was brought from Holland. The soil of the garden is little better than sea-sand; this was trenched two feet deep, and a thick layer of sea-weed was put in the bottom of the trench, and well pressed together and beat down. This was the only manure used either at the first planting, or at subsequent dressings: there was an inexhaustible supply of the article generally at hand, as the back-door of the garden opens to the sea-shore.”

155. *Result of actual experiment.*—After the abundant matter that has been given from a great variety of authorities, it only remains to adduce the results of an actual practical experiment on

the cultivation of this delicious vegetable, the detail of which will serve to illustrate and certify much that has been advanced.

On the 18th of March, 1824, four rows of *two years old plants* were planted in a bed about fifteen yards long. The surface-ground was in tolerably good heart—it had been used and manured for vegetable crops; but the sub-soil was wholly artificial, the pre-occupier of the spot having converted a saw-yard and timber premises into a garden, by laying the foundation with a body of calcareous road-sand over a stratum of cold blue clay; hence, the real soil was barely eighteen inches deep. I caused this to be trenched as deeply as possible; the ground out of the first trench was wheeled to the opposite end of the bed, and the bottom being cleared, a good layer of stable manure was placed all along it; then the mould of another piece of ground, of equal breadth, was turned into the trench upon dung, thus proceeding trench after trench, the whole was manured at the bottom, and all the ground was turned and well worked. On the facility of performing this work, I remark, that the trenching was performed by a boy with a wooden leg, and it was done in a few hours. I have subsequently prepared several beds, in various ways, always however causing the ground to be deeply trenched and manured; and the work has been effected by mere youths;—and if, as I shall prove, fine asparagus can be speedily procured with such very trifling exertions, let no one shrink from the attempt to obtain so fine a vegetable, through the fear of not being able to do it without a great deal of trouble, and of incurring the risk of considerable and hazardous expenditure. But to return to the subject:—The work of trenching having been completed, the soil to the depth of about two inches was raked off the surface of the whole bed, and drawn on each side; the bed was made level and smooth, and the line strained tight, at twelve inches within one of the intended edges of the bed, the limits of which were set out, and marked by driving six strong stakes nearly a foot into the ground, with the upper ends projecting at least six inches above the level of the adjoining ground. The asparagus plants were set by the line, not in a trench, but by simply placing them on the surface, the crowns in the centre and uppermost, and the fibres extended, and spreading horizontally on the soil. When a row was thus placed, soil, finely broken, was put on them carefully, so as just to secure them in their places; and then, another space was laid out by the line, one foot within the first:—thus four rows were planted, each plant being about twelve inches apart every way, the spreading of the roots requiring a very considerable space. Finally, more soil was cautiously added, till the crowns were covered to the depth of

at least two inches. I set the plants with my own hand, and did the *whole* work except the trenching; and three or four hours sufficed to complete it. What then is the amount of such labour, and what the reward?—We shall see. The covering had employed all the loose soil; the line was now strained twelve inches beyond the outer rows, by the stakes, and each edge of the bed beaten a little with the spade, and cut slanting, so as to leave the base of the bed three inches wider than its surface. The loose earth collected in forming two alleys, each about a foot wide, was thrown partly over the asparagus bed, and partly over the adjoining compartments; and this loose earth, spread over the whole bed, raised its surface to about three inches above the crowns of the plants. The alleys were dugged six inches below the top of the bed, their four edges cut as neatly as the light condition of the soil would admit, and then a covering of coal ashes was laid along the alleys, the bottom of which had been beaten smooth with a spade. A light raking finished the operation. Weeds were subsequently kept under; and in autumn, after the stalks became brown and were removed, a covering of rotten dung was spread over the bed, and this dung was covered with more earth digged out of the alleys; then every part was raked and cut in the neatest manner, and more ashes were laid on the alleys. In March 1825, the bed was lightly forked, and dressed with the rake; some of the crumbs being drawn off the bed into the alleys. The plants advanced strongly, but some had perished, and all were late; and it became necessary to fill up many of the blanks with fresh, strong plants.—From this circumstance, I should suspect the merits of the mode of planting, by spreading out the roots, and in future, would adopt the usual mode of trench planting, (see No. 151.) In 1826, above 700 fine heads were cut, and the same treatment was pursued. In 1827, above 1100 were cut; and, in 1828, 1292. The cutting began on the 28th of April, and finished on the 24th of June, 1828.

The bed was regularly manured, the edges cut, and earth thrown on the surface early in November. Twice, I had road drift-sand, with about two pounds of salt thrown on the surface: this was the dressing of November, 1829.

Judd's method of planting had not been seen, and consequently could not be adopted; however, as all agree that richness of soil, and depth of trenching, tend to produce a good and *tender* plant, his plan seems unexceptionable, unless it be in that part which directs the filling up of the alleys with long dung; for, although by that method he avoids the wounding and exposure of many fibres which project towards the alleys, yet, if these alleys be of any use at all,

they can be so, only as long as they continue open, and this they cease to be—in fact, they become portions of one wide bed, when plants have taken possession of them. Gardeners direct narrow *beds* and broad *alleys*, to secure the convenience of easy access; but these alleys would soon exist only in name, and become portions of one extended, wide plantation, were the roots suffered to spread abroad in the rich soil produced by the dung. Judd has overlooked this circumstance, or otherwise, has failed in his mode of describing his process.

156. *Further experimental remarks.*—I see no reason to doubt the advantage of trenching to the depth of two feet at least, in a soil consisting of a pure, unctuous, sandy loam, of a velvety texture; or, if that be not found in the garden, to introduce the top-spit, *grassy turf*, of a sheep-common, or meadow. The manure I should prefer, would be semi-decayed leaves, to the extent of one-third of the soil, perfectly incorporated with the earth, and improved by adding about a peck of *soda* to the entire soil of every large bed—as the one described above. Wood ashes are also an excellent adjunct as a top dressing.

*Alleys* are of little use, only as they facilitate the taking of the crop.

The single, distant bed, as described by Grayson, is eligible, in as far as it may be improved by the adjoining intermediate crops, on the theory of “radical exudation;” but the greatest advantage attached to it is this,—that if alleys be dugged out on the sides of the bed, eighteen inches wide, and one foot deep, the bed may be forced, by placing a pair of boards as a ridge, over the plants, and filling the alleys with fresh, damp leaves, which also should be applied over the whole surface of the bed and its boards, two feet deep. Much trouble would be occasioned by the processes, but the asparagus would be obtained early, and receive no injury; whereas, in frame-forcing, every root is destroyed. The leaves, when the crop is cut, should be taken off the bed; but those in the alleys left, digging them over in the autumn, at the time of top-dressing; when half may be laid over the bed as manure, and the alley filled to a level with long litter. Beds so formed, ought not to be forced every year.

By the above method of forcing the asparagus would be bleached, but to obviate this circumstance, (which is an objection,) very complete beds might be formed, by building pigeon-holed, single brick walls at the two sides and ends of these narrow beds, so as to make them thirty inches wide; the walls ought to be built solid, six inches above the surface, and secured by a wooden curb. Leaves,

hot dung, or a mixture of both, so as to form a hot lining all round, as high as the wall, and a yard deep, would produce sufficient stimulus. The beds should be hooped over within the walls, the centre of the arch being eighteen inches above the soil, and covered with mats every night; thus, asparagus of good colour would be obtained. The gardener may cover the earth of the bed with six inches of the siftings of half decayed leaves, mixed, if possible, with about a fifth, or sixth part of wood-ashes. These should be laid on as soon as the bed is forked over, and just previous to the formation of the linings: boards, or basket-hurdles might be substituted for the brick walls, where economy, *in the first instance*, is an object.

157. *Duration of the beds.*—Judging from all that has been advanced, the conclusion we arrive at is, that asparagus is a plant as hardy as groundsel or horse-radish; that it will grow in sand, and needs no protection; that a bed capable of producing 1100 or 1200 heads every year, may be constructed with a degree of labour so small, and so delightful, that to many at least, it may be said to “physic pain:” and at an expense, when performed by the members of the family, too trifling to be placed in competition with the rich and durable results. Reckoning 160 plants, two years old, at two and sixpence per hundred; the manure, if *purchased*, at four shillings per load; if *produced*, at an *optional* value; the labour, at the price of the acquisition of health and strength, if it be prudently undertaken and performed—what then is the sum total? not one pound! And as to the subsequent labour in keeping clean, cutting, and autumnal manuring, with a view to improve the quality of a plant, which assuredly is *benefited* by rich tillage, a few hours throughout the whole year will certainly suffice; and if *dung* cannot be procured, road or sea-sand, leaf-mould, and two or three pounds of common salt, will amply provide a winter covering, possessed of good fertilizing qualities. In point of *total duration*, some allow the plantations a period of ten years, others extend it to twenty and thirty years. Mr. Cobbett says, that it depends on the soil. “Having a dry bottom, and good manure, they (the beds) will probably last three generations; and if that be not enough to compensate the trouble of making them, it would be difficult to find a compensation.”—*Amer. Gard.* Dr. Macculloch (*Caled. Mem.*) says, “the French beds will generally last thirty years; but if they be planted in such abundance as to require cutting once in two years, half the beds being always in a state of reservation, it will last a century or more.”

158. *Cutting and duration of the crop.*—It will be imprudent to cut any asparagus till the heads rise freely, and of considerable size.

The best instrument is a common sharp dinner-knife, narrow in the blade, and rather pointed. When the heads have advanced to the height of six or seven inches above the surface of the ground, thrust the knife carefully, close by each head, and pass the cut in a slanting direction, forwards and downwards, two or three inches within the surface of the bed, observing great caution not to wound other advancing heads on either side of the one to be cut. Cut them in regular succession as they advance, and select those which appear to produce more than one shoot; for it should ever be a rule to leave one on each crown at the close of the season. The reason for so doing, may be given in a few words. The root of every plant is derived or produced from buds or leaves; by the latter, the crown and its roots, of all herbaceous plants in particular, are formed and nourished. If then, *all* the stems of the asparagus plant be cut, there can remain no foliage to receive the influence of air and light; consequently, no vital fluid can be furnished to the plant under the soil, and the whole of the roots must perish, for the want of the supply of those juices, which would be devoted to the production of a fresh crown, destined to remain dormant during the winter, and to expand into new heads and shoots, when excited by the influences of the returning spring.

In a *new plantation*, cut only the largest, and spare the weaker, to strengthen the roots. By the mode of long cutting, adopted by me, as above directed, I gain a length of *eatable* grass of full six inches; sometimes, we have not had enough of white left, to *hold the shoot* by; but then, this is an economical plan, and the grass is *green*; hence, there is nothing of elegance in it. To obtain the fashionable red-tipped grass, the heads must be cut when they just emerge, and the knife must be passed down more deeply, or else, each head must be earthed up as at No. 151; the result will be *one inch* of an eatable summit, of very inferior flavour comparatively, and *six inches* of hard, fibrous, white stalk, as tough as pack-wax. Asparagus beds may be cut, according to the season, from mid-April to the third week in June. At the close of each season, blanks may be filled up, by reserve two years' old plants from small seed-beds, or these plants may be purchased. As the plants *ripen their seeds*, remove them carefully, so as to prevent the seeds from dropping on the beds; and when all the haulm is cut off, sweep the beds; ~~for~~ although many persons let the seeds that drop, lie on the beds ~~and~~ grow, yet the consequence is total irregularity among the plants, both as respects depth and situation.

159. *In saving the seed*, nothing more is required than to select *the largest, most forward, and best ripened plants*; and no art is

required in constructing a seed bed ; a little neatness and regularity as to order, and choice of the spot, is all that can be required. Before sowing, rub the seeds out of the husks, not, however, before they are wanted.

## PART II.

### OPERATIONS IN THE VEGETABLE GARDEN, FOR THE MONTH OF APRIL.

160. *First week to the third.*—Sow—Beans (22), the long-pod, Sandwich, Windsor, or Toker ; also,

Peas (24), imperial, Prussian, and marrow-fat, once or twice ; or whenever the last-sown crops appear above ground (26).

Cabbages (108), Savoy (116), Red-cabbage (115), Brussels sprouts (117), Borecole (118), about the first or second week.

Beet-root (72), early in the month ; carrots (76), parsneps (78), about the second week, for main crops ; or for succession, if the chief crops were sown last month.—Lettuce, small salads, and spinach, for succession.

Onions ; the Spanish for main crop ; the silver for drawing young.

Leeks and cardoons. Celery and celeriac, in a warm spot of ground.

*Third week.*—Broccoli (124), the different sorts, once or twice ; and the purple-cape, by M'Leod's method, to obtain an early autumn supply (123).

Cauliflower (121), and all the sweet herbs ; also nasturtium, parsley, and turnips.

Radishes : the tap, and turnip-rooted, twice or thrice.

*Fourth week*—Kidney-beans (30), scarlet-runners (31), for the first crops ; and salsafy, scorzonera, and skirrets.

*Plant*—Potatoes for the summer and autumn supply.

Asparagus-beds (151), artichokes from suckers, in rows, each plant four or five feet apart.

Slips of balm, pennyroyal, sage, thyme, savory, marjoram, rosemary, and lavender.

*Transplant*—Lettuces, to thin the seed-bed ; and all other crops that require transplanting.

Sea-kale from beds of young plants, or from cuttings of roots, with two or three eyes or buds.

*Fork and dress*—asparagus beds as early as possible, if that work

remain to be done; *dig* about artichoke plantations, after removing the suckers; *hoe* and thin spinach, and all other drilled drops.

*Earth up*—the rows of peas, beans, and other crops, when two or three inches high. *Stick* peas before they incline to fall.

*Hoe*—between all crops, and eradicate weeds with the hand, where hoeing cannot be practised.

*Destroy*—slugs and snails: these insects are great enemies to young lettuces, peas, broccoli plants, &c.; seek for them early and late; and sprinkle quick-lime dust about or around drills and patches; or water copiously with clear lime water, made by slaking half a pound of fresh-burnt lime in a three-gallon pail, by pouring a pint or more of water upon it, and then filling up the pail with cold water.

### SECTION III.

#### PART I.

#### NATURAL HISTORY AND CULTIVATION OF THE APRICOT TREE.

*Armeniaca Vulgaris* (*Rosaceæ*). Class xii. Order i. *Icosandria Monogynia*, of Linnæus.

161. The Apricot-tree, though it in many respects resembles the peach and nectarine trees, and, like them, is reckoned among the choicest of our wall-fruit trees, is, in reality, a species of a distinct *genus*. The *genus* is now separated from *Prunus*. The essential generic character is,—“an inferior calyx; petals, five; nut of the *Drupa*, with slightly prominent seams.” *Smith*. The flowers appear in March; they rise from shoots of the preceding year, or from spurs of two or more years’ growth; and the fruit ripens in August or September. “From its trivial name, it is generally supposed to have originated in Armenia; but Regnier and Sickler assign it a parallel between the Niger and the Atlas; and Pallas states it to be a native of the whole of the Caucasus, the mountains there, to the top, being covered with it. Thunberg describes it as a very large, spreading, branching tree, in Japan. Grossier says that it covers the mountains to the west of Pekin; that the Chinese have a great many varieties of the tree, double-blossomed, which they plant on little mounts for ornament, and dwarfs in pots, for their apartments. It appears from Turner’s *Herbal*, that the apricot was cultivated here, in 1562; and in Hakluyt’s *Remembrancer*, 1582, it is affirmed, that the apricot was procured out of Italy by Wolfe, a French

priest, gardener to Henry VIII. The fruit seems to have been known in Italy in the time of Dioscorides, under the name of *Præcocia*, probably, as Regnier supposes, from the Arabic, *Berkock*, whence the Tuscan *Bacocche*, or *Albicocco*, and the English *Apricock*; or, as professor Martyn observes, a tree, when first introduced, might have been called *a præcox*, or early fruit; the gardeners, taking the article *a* for the first syllable of the word, might easily have corrupted it to apricocks. The orthography seems to have been finally changed to apricot, about the end of the last century, as Justice, in 1764, writes “apricock;” and Kyle, of Moredun, in 1782, “apricot.”

*Varieties.*—Parkinson, in 1629, enumerates six; the Luxembourg catalogue, in 1800, and the British catalogues, mention about fifteen. The choice varieties for gardens of moderate dimensions are:—

The *Moor-park*, brought from the Netherlands by Sir Thomas More, in 1700; ripens in the end of August; a most excellent fruit.

The *Breda*, early, introduced in 1702; an excellent sort for a standard tree; ripens in August.

The *Masculine*, mentioned by Parkinson in 1629; ripens in July or August; greenish, of a tartish flavour, and esteemed for its precocity.

The *Brussels*, rather oval, red, with dark spots, and greenish yellow; brought from Brussels in 1702; ripens late in August, or in September; the pulp not mealy, and the tree a great bearer. (See *Encyc. of Gard.*, Nos. 4522, 4524.)

The *Peach-apricot*—*Abricot pêche* of Du Hamel—a fine, high coloured fruit. (See LINDLEY'S *Guide*, p. 133.)

162. *Propagation* is effected by budding the different varieties upon plum-stocks, raised from stones of the fruit. For standards, the Brussels and Breda are budded upon the St. Julian plum. Lindley says, “I am persuaded that if it were budded upon the *Muscle*, the trees would be better, last longer in a state of health and vigour, and produce their fruit superior both in size and quality.” (*Guide*, 1831, p. 137.) “Knight recommends budding the Moor-park on an apricot-stock, which he has found prevents the trees of this sort from becoming diseased and debilitated, which they generally do on plum-stocks. For dwarfs, the bud is inserted six or eight inches from the ground: and the sorts are sometimes twice budded, or one variety is budded on another, which is said to keep the trees in a more dwarf state. For riders (high wall-trees), or standards, they are budded on plum-stocks, four or five feet high.

Miller prefers half standards, budded about three or four feet from the ground, being less liable to suffer from winds." (*Encyc. of Gard.* 4526.)

163. *Planting*.—After budding, if the operation succeed, the plant will remain perfectly inactive till the following spring, when, each stock being headed down just over the bud, the bud will shoot with vigour, and probably attain a length of two or three feet by the succeeding autumn; at which time, or in the spring following, the young trees may be planted out against the walls where they are to remain; or they may continue in the nursery to be trained; "observing, in either case, that the first main shoots, produced as above from the budding, are to be pruned, or headed down in March, to six or seven eyes, to gain side shoots from the lower eyes the following summer, wherewith to form the head." The proper season for planting is from October to February or March, according to Abercrombie; in August, according to Forsyth, when the leaf begins to fall. The Breda and Brussels, it is said, produce more highly-flavoured fruit, in fine seasons, if they be planted as standards, or espaliers, in warm situations. The other sorts should, in the opinion of Miller and Forsyth, be planted as wall-trees, and have an east or west aspect; the great heat of a full south aspect tending to produce a mealy quality in the fruit. Abercrombie says, "choose a south or south-east and west situation, having a broad border properly prepared by digging, and application of good dung: if the head is already formed, only prune out the irregular placed and fore-right shoots; and after shortening the select regular shoots to about two-thirds of their natural length, train them in horizontally, five or six inches asunder.

*Training*.—"The fan method is very generally adopted with this tree. Forsyth prefers the horizontal manner, and Harrison also trains horizontally, but "so as to let the branches have an elevation at their extremities of twenty degrees, varied, however, according to the luxuriance or weakness of the tree." Abercrombie says, "train in horizontally, five or six inches asunder, being careful to increase the number of branches annually, till they cover the wall completely." I have always observed that, the taller the tree, the greater is the quantity of fruit; and therefore when a tree, as we often see it on cottages, is trained with five or six leading branches against a wide chimney, the quantity of fruit is increased threefold. The apricot is benefitted by whatever tends to stimulate its foliage to early action. Hence a perpendicular growth, a little gentle warmth, and secure protection against east winds, are favourable concomitants.

164. *Pruning*.—Every year, the wall and espalier apricots must be regularly pruned twice; in summer and winter: an intermediate pruning, or autumnal regulation, may prove of great advantage to the tree: it will be noticed hereafter.

*The Summer Pruning* begins in May; and then, rub off, with the thumb nail, or prune close out, all irregular, young, advancing wood-buds, when an inch or two long. In a fortnight or month after, about the beginning of June, go over the trees again, and prune out with the knife, all ill-placed shoots arising in any parts where they cannot be trained with proper regularity. Prune out, also, very luxuriant, rank shoots, and all that are redundant, carefully preserving a full supply of the best placed shoots of middling strong growth in all parts of the tree. Displace, generally, all weak twigs, unless in places where no others occur, when, only leave the strongest thereof; and leave in most cases a good leading shoot to each main branch and bearer, to draw the nourishment more effectually. Likewise, if any good shoots occur towards the bottom of the tree, retain such of them as appear necessary, both as bearers, and to furnish future, successional bearing wood; so that the lower part, middle and upper parts of the tree, may be always filled with bearing wood. Cut out useless shoots as close as possible, without leaving any stump or spur; and if any select shoots retained for training have produced lateral twigs, cut these clear off, but preserve the main shoots at their full length, and do not shorten in the summer pruning."

*When the fruit is set*, it may be advisable to remove all shoots which proceed from the bearing branches, excepting those which serve to convey nourishment to the fruit; and such are those *above the fruit*; because the leaves, being the chief laboratories of the sap, return the proper juices by the vessels of the footstalk and bark; the shoots, therefore, to be removed at this time, are those which are below the fruit, and which have pushed out during the same season: prune all such away, unless it be a lower one selected to remain as a *succession* shoot.

"If any tree assume either universally, or partially, a luxuriant state of growth, producing rank, vigorous shoots, which never become good bearers till they be reduced to a moderate state, retain as many of these shoots in all parts, or in any part of the tree, as can be conveniently trained in, and at their whole length all summer; and continue this method for a year or two, in order to divert and exhaust the redundant sap, and thus check the luxuriance, and gradually to reduce the tree to a habit of moderate shooting, and furnishing middling strong, and proper bearers. Afterwards, prune and train

the tree in the common method.”—(Selected chiefly from ABERCROMBIE'S *Gardener's Dictionary*, “*Apricot*.”)

165. *Winter Pruning*.—The directions for pruning the *Peach*, (No. 85,) will, in a great degree, apply to the *apricot*; but it must be remarked that, in the latter, there are, on the two years' old branches, some short natural spurs, about an inch or two in length, and on these, blossom buds and good fruit are frequently produced. Some people cut these spurs entirely off; but this plan must be objectionable: if however, the spurs be naked, and advance considerably *foreright*, they should be removed, or cut back to one or two of the lowest buds. With this proviso, concerning the short natural spurs, observe, as in the peach, to leave every year a due supply of last summer's shoots, in distances of about six inches asunder, and in regular order, quite from the bottom: at the same time a proportionate share of the two former years' bearers, and naked old wood, must be retrenched; for as this tree produces its fruit principally upon the young shoots of the former summer, the fruit rising directly from the eyes of the shoots, a plentiful supply must be reserved annually, to train for bearers. Select the most promising and best situated of these shoots, and then observe, that the young shoots retained, must be more or less shortened, to encourage them to produce not only fruit, but a supply of bearing shoots to bear the next summer; and in this shortening attend to their original growth and strength. If the tree be neither vigorous nor weak, the shoots should be pruned about one-third of their whole length: thus, a shoot of about fifteen or sixteen inches length, should be pruned to about ten inches, while those which are only about a foot long should be pruned to about six inches in length. If, then, the tree be weak, prune short; but if it be very vigorous and luxuriant, prune long; and occasionally, let the young branches be left at their full length; for the more the wood of a vigorous tree is cut out, and the more the shoots are shortened, the more vigorous will be the growth of the tree. *Observe particularly*, that all shoots should, if possible, be cut to an eye that is likely to produce a leading shoot—that is, to a wood-bud; which may be distinguished from a fruit-bud by being long and flat; whereas, the latter is round and swollen. After pruning and shortening, nail the tree in regular order, and remark, that, before pruning, it will be prudent to unnail a great part of the tree, as it will facilitate the examination of the branches, and give freedom to the pruner in using the knife.—(Selected chiefly from MAWE'S *Calendar*.)

166. *Intermediate pruning*.—As soon as the fruit is all gathered, each branch that has borne, if it be not furnished with young spurs,

might be shortened or pruned quite down to one of its own young lower shoots, which thus will replace it. This *remplacement*, as the French term it, is peculiarly suitable to the *peach*; and it provides a good supply of vigorous and well placed young wood every autumn, and prevents a crowding of the shoots; but these shoots must not be shortened,—that operation must be deferred till the final pruning.

Pruners who adopt the modern practice, endeavour to obviate as much as possible, winter cutting, by disbudding early in the spring. The supernumeraries are checked by pinching back, or entirely obliterating them with the thumb and fore finger; and the process becomes one of foresight and prevention.

167. *Thinning the fruit*.—In May, or early in June, remove all the young fruit that touch one another; leave none nearer than four or five, some say six, inches from each other. Mr. Cobbett says, that “a tree eight feet high, and spreading seven feet on each side of the trunk, will cover a space of 112 square feet; the fruit, at six inches apart, would be four apricots to a foot, that is, four hundred and forty-eight apricots on the tree.”

168. *Diseases of the tree*.—The apricot tree is not liable to mildew, nor is it so much injured by insects as the peach and nectarine: the wood is hard, and the bark firm and glossy; but the branches are subject to a disease which causes an exusion of gum; and, what is of more consequence, the tree, or some of its largest branches, are sometimes affected by a kind of blast, which destroys them as suddenly as if they were struck by lightning. I once saw an old tree, that had produced hundreds of fruit in the preceding summer, had set well for bloom in the early months of the next year, had expanded that bloom and a portion of the young leaves, and was to all appearance in perfect health at the close of one day; this tree, on the following morning, was entirely dead; every blossom had collapsed or fallen, and every leaf was withered! No one has heretofore suggested a satisfactory reason for this sudden blast, which is not of rare occurrence, at least to a partial extent. I think it has an electric origin: I do not mean that it is occasioned by a shock or stroke of electricity, but that the tree, by its physical organization, is very probably liable to an interruption of the ascending or propelling current; which, when it occurs, produces an effect as sudden and manifest as that of a paralytic stroke in the human frame, and is more immediately fatal, since it includes a total cessation of all the ascending vital fluids of the tree, or those at least of one or more of the inner branches.

## PART II.

## OPERATIONS IN THE FRUIT DEPARTMENT.

169. *Plant*—Trees of various kinds. This work of planting may still be performed; but if delayed beyond the first week, it had better be deferred till the autumn. If the weather be very dry, water fresh set trees, copiously and much about the stems, over the roots.

*Train and nail*—wall-fruit trees. The blossoms of most trees now trained; will be liable to injury, and the trees must be expected to bleed, if pruned.

*Look over*—the trees, and disbud, *i. e.*, remove, with the thumb-nail, surplus and weak foreright shoots of apricots, peach trees, &c. If insects or mildew appear on the leaves, a little flowers of sulphur dusted over the young shoots may prove very useful; it is strongly recommended by some writers. Keep the fruit borders, raspberry, gooseberry, and currant beds, in good order, and free from weeds. Attend to the strawberry beds, keep them clean, and water them effectually if the weather be very dry.

*Grafting* may still be performed, particularly by the crown method. Repair the clay of former grafts if it be cracked or injured. Destroy insects of every description.

## MISCELLANEOUS.

170. *Plant*—most kinds of evergreens; not only the common sorts, such as laurel, Portugal laurel, laurustinus, bay, evergreen oak, gum cistus, &c., but those which flourish best in heath mould or bog earth; as, rhododendrons, magnolias, andromedas, and the like.

*Sow*—annual seeds; set perennial flower roots, cuttings, and offsets.

*Introduce*, wherever it is possible, the beautiful *orchis tribes*; these plants move well when they are in flower; dig round them with a rounded trowel till the roots come up without injury; set them in holes of corresponding size, and then give water. The *orchis morio*, or purple and green orchis, with its rich varied tints, will sometimes continue in flower for five or six weeks: it grows in meadows where the soil is moist and approaching to clay.

*Protect* auriculas, in pots; these beautiful and fragrant flowers should stand on a stage, facing the east, with a covering at the top to guard them against heavy rains.

*Roses* and other ornamental flowering shrubs in pots, should have fresh mould added to the surface: remove dead twigs and leaves,

and give gentle waterings occasionally. Loam and bog-earth mixed in equal proportions, and kept in a heap all the winter, form a capital compost for most of the ornamental plants in pots, the *heaths* excepted.

*Select Trees, Shrubs, and Border Plants in flower this month.*

171. *Trees and Shrubs*.—Pear tree, *Pyrus communis*; Cherry tree, *Prunus cerasus*; fly Honeysuckle, *Lonicera xylosteum*; Rhodora, *Rh. Canadensis*; Lilacs, *Syringa*. *Evergreen-shrubs*.—Several species of *Andromeda*; of Whortleberry, *Vaccinium*; and one or two Heaths, *Erica*; *Pontic Rhodendron*, and other species; Currant, the golden and crimson, *Ribes aureum et sanguineum*.

*Herbaceous plants*.—Anemones, wood, double, and pasque flower, *An. nemorosa, flore pleno, var.; et pulsatilla*; Double violet, *Viola odorata fl. pleno*; Dog's violet, *Viola canina*; Spring snow-flake, *Leucojum vernal*; Primrose,—common, double, Chinese, &c. *Primulæ*; Spring Gentian, *Gentiana acaulis*.

*Bulbous roots*.—Canada Bloodwort, *Sanguinaria Canadensis*; Hyacinth, *Hyacinthus orientalis*; Tulips, yellow, Van Thol, *Tulipa sylvestris et suaveolens*; Daffodil, Primrose peerless, *Narcissus biflorus*; Fritillary, Snake's head, and Crown imperial, *Fritillaria meliagris et imperialis*.

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## THE NATURALISTS' CALENDAR.

## APRIL

THE name of the month is derived from a word which signifies opening, (*Aprilis, Apertilis ab aperiendo,*) and the character of the season justifies the name: the buds expand, as it were, at once; and every fine sunny day causes so sensible an advance in the progress of vegetation, that the most superficial observer cannot fail to be struck with the rapidity of the work. The month is, however, not less distinguishable for the opening of the buds, than for the arrival of the early, soft-billed birds of passage. The season is liable to great mutations, and is as frequently visited by cold, parching, and durable east winds, as by those genial showers which were formerly hailed as the precursors of the flowers of May.

The average height of the Barometer is about 29 inches 9 cents.

Ditto                      Thermometer                      49 deg. 9 tenths.

*In the first week.*—The sweet wild note of the black-cap (*Motacilla atricapilla*) is sometimes heard; snipe (*Gallinago minor*) pipes.

*Second week.*—Nightingale, (*Motacilla lusinea*,) red-start, (*Motacilla phœnicurus*,) yellow willow-wren, (*Motacilla salicaria*,) arrive and soon come into full song; swallow (*Hirundo rustica*) arrive about the 10th, 12th, or in the

*Third week,*—also the martin, (*Hirundo urbica*); cuckoo (*Cuculus canorus*) is heard; tit-lark, wood-lark, grasshopper-lark, (*Alauda pratensis, arborea, et tritialis*,) sing;—the note of the last (as Wh says, "*cantat voce stridula locustæ*," ) may easily be mistaken for chirping of a cricket or grasshopper.

*Fourth week.*—White-throat (*Motacilla silvia*) sings; this is remarkable for the odd gesticulations it makes while singing the wing, just before it alights on a bough of a tree; wry- (*Jynx torquilla*) is heard; this bird is considered as the precursor the cuckoo; the wren, chaffinch, skylark, blackbird, &c. &c. con in full song.

## M A Y.

## SECTION I.

## SCIENCE OF GARDENING.

## PART I.

## LIGHT.

172. *Nature of Light*.—LIGHT is described as that peculiar principle, or emanation from a luminous body, by which objects are rendered perceptible to our sense of seeing. Philosophers, from a very early period of time, have made light a subject of speculative inquiry: the beautiful vision, however, has eluded their researches, and its real nature is still deeply involved in mystery. Little, indeed, is actually known beyond the results of those experiments which men of inquiring minds have instituted, in order to ascertain some of its general properties. What we *know* of light, we know by its effects.

Whatever may be the nature or the cause of light,—whether it be a material substance, composed of particles directly thrown off from the sun,—or a mere *emanation*—a modification—a something which produces impressions, but possesses in itself no properties in common with those of *matter*,—whether it be a fluid *sui generis*, diffused throughout all nature, and revealed to the eye, as sound is to the ear, by vibrations or pulses, produced by the agency of a luminous body,—or, finally, whether (as indeed appears the most probable conjecture) it be an *electrizing* principle, which acts by inductions, and effects chemical decompositions and combinations, infinitely varied, but all in harmonious unison,—whatever, indeed, be its nature, certain it is that light exists, that it produces impressions and determinate effects, that it is governed by immutable laws, and is possessed of general properties, some of which having been already ascertained, there is reason to hope that, as science advances, the *nature* of light itself may, to a greater or less extent, be accurately determined.

It would be unprofitable to the reader to impose upon him the task of wading through the mysticisms of philosophical speculators. They who are desirous of becoming acquainted with the great

variety of contradictory hypotheses which have been advocated, are referred to Dr. HUTTON's *Mathematical Dictionary*.

I shall select a few paragraphs from the article on LIGHT in that work; and these, with some other interesting quotations, will enable the reader to determine what were the opinions of Sir Isaac Newton and of his followers, and what the present state of our knowledge of the laws by which light is governed, and of the effects which it produces.

173. *Newtonian Theory*.—"The Newtonians maintain that light is not a fluid *per se*, but consists of a great number of very small particles, thrown off from the luminous body by a repulsive power with an immense velocity, and in all directions: and these particles, they also assert, are emitted in right lines: which rectilinear motion they preserve, till they are turned out of their path by some of the following causes; *viz.* by the attraction of some other body near which they pass, which is called *Inflexion*; or by passing obliquely through a medium of different density, which is called *Refraction*; or by being turned aside by the opposition of some intervening body, which is called *Reflexion*; or, lastly, by being totally absorbed by some substance into which they penetrate, and which is called their *Extinction*." "Sir Isaac Newton observes, that bodies and light act mutually on each other; bodies on light in emitting, reflecting, refracting, and inflecting it; and light on bodies, by heating them, and putting their parts into a *vibrating motion*, in which *heat principally consists*. For all fixed bodies, he observes, when heated beyond a certain degree, do emit light, and shine; which shining, &c. appears to be owing to the vibrating motion of their parts; and all bodies abounding in earthy and sulphureous particles, if sufficiently agitated, emit light, which way soever that agitation be effected. Thus, sea-water shines in a storm; quicksilver, when shaken in vacuo; cats or horses, when rubbed in the dark; and wood, fish, and flesh, when putrified." (HUTTON'S *Dictionary—Light*.)

174. *Velocity of Light*.—"The velocity of the particles of light is truly astonishing, amounting to near two hundred thousand miles in a second of time, which is near a million times greater than the velocity of a cannon-ball. It has been found by repeated experiments, that when the earth is exactly between Jupiter and the sun, his satellites are seen eclipsed about  $8\frac{1}{2}$  minutes sooner than they could be according to the tables; but when the earth is nearly in the opposite point of its orbit, these eclipses happen about  $8\frac{1}{2}$  minutes later than the tables predict them. Hence then it is certain that the motion of light is not instantaneous, but that it

takes up about  $16\frac{1}{2}$  minutes of time to pass over a space equal to the diameter of the earth's orbit, which is at least 190 millions of miles in length, or at the rate of near 200,000 miles per second."—(*Idem.*)

175. *Chemical Properties of Light.*—All nature affords ample testimony that light possesses chemical properties in a very remarkable degree. Hence it may be the primary agent of all chemical inductions, particularly of those that take place in the vegetable kingdom. Lavoisier observes, that "the combinations of light, and its mode of acting upon different bodies, are less known than those of caloric. By the experiments of M. Berthollet, it appears to have a great affinity with oxygen, is susceptible of combining with it, and contributes along with caloric to change it to a state of gas. Experiments upon vegetation give reason to believe that light combines with certain parts of vegetables, and that the green of their leaves, and the various colours of their flowers, are chiefly owing to this combination. This much is certain, that plants which grow in darkness are perfectly white, languid, and unhealthy, and that to make them recover vigour, and to acquire their natural colours, the direct influence of light is absolutely necessary."—(*Elem.* vol. i. 299. Art. *Light.*)

176. *Colourific Principles of Light—its Refrangibility.*—Before we proceed further to investigate the chemical energies which light exerts upon vegetables, it will be proper to take a view of some of those experiments which have led to the received hypothesis of colours; and then to consider the grounds upon which philosophers have concluded that light possesses a colourific principle, and that plants derive their colours from combinations with this principle.

Sir Isaac Newton made a circular aperture, of about one-third of an inch in diameter, in the shutter of a dark room, and placed near the aperture a glass *prism* (that is, a triangular bar of highly-polished glass, whose angle of refraction was about  $64^{\circ}$ ) in such a position, that the beams of the sun might be thrown upon, and pass through it, and then be received by a screen, placed about eighteen feet and a half from the prism. The beam of light, if nothing had intervened, would have passed through the aperture in the shutter, and then proceeded in the direction of the dotted lines of the annexed figure; but, by a power which glass, among many other substances, possesses, the beam, on touching one of the three faces of the prism, was *refracted* (bent or broken), and thrown upon the screen in an oblong figure or *spectrum*, the length of which was about ten inches and a half, and the breadth two inches and one-eighth. This figure or image contained seven colours, "which Sir

Isaac conceived to be composed of an infinite number of circles overlapping each other."

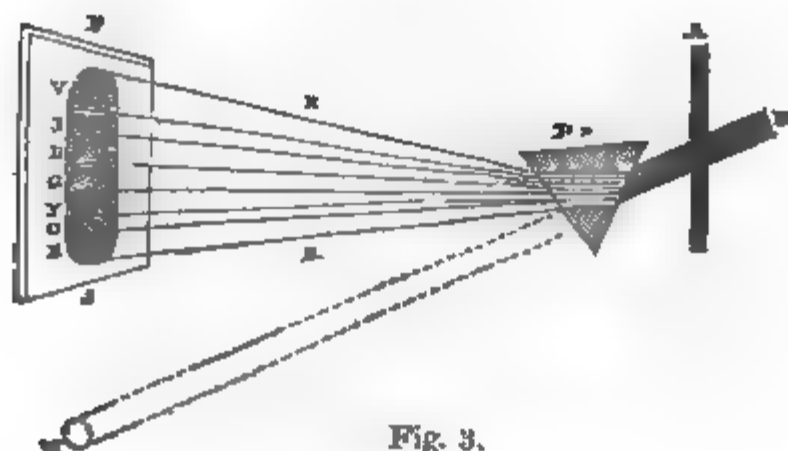


Fig. 3.

B (fig. 3) is the solar beam, which, passing through the aperture in the shutter A, would have proceeded to W, and there have formed a spot of *white* light. *Pr.* is a section of the prism; the rays X are twice bent, first on entering, and again at emerging from the prism, and that, in different degrees or angles. After thus passing through the prism, these rays proceed severally, each according to its angle of refraction, till they reach the screen, P S, where they form the image of seven colours, in the order described.

177. *Refractive Powers of various Substances.*—The treatise on "*Optics*," of *The Library of Useful Knowledge*, contains, at pages 5 and 6, a list of nearly two hundred substances possessing different refractive powers. "It well appears," says the writer, "from a comparison of the preceding table, with that of specific gravities in '*Hydrostatics*,' chap. 6, that in very many cases the refractive power increases with the density of the body. In the case of oily substances, or inflammable bodies, however, such as *hydrogen*, *phosphorus*, *sulphur*, *diamond*, *bees' wax*, *amber*, *spirit of turpentine*, *linseed oil*, *olive oil*, and *camphor*, their refractive powers are from *two* to *seven* times greater in respect to their density, than those of most other substances. Sir Isaac Newton observed this fact with respect to the last *five* of these substances, which, he says, 'are fat, sulphureous, unctuous bodies;' and as he observed the same high refractive power in the diamond, he infers, that it is 'probably, an unctuous substance coagulated.' This law, however, at one time seemed to be overturned by an observation of Dr. Wollaston, that '*phosphorus*, one of the most inflammable substances in nature, had a very low refractive power;' but Dr. Brewster, confiding in the truth of the law, examined the refractive power of phosphorus, by forming it into prisms and lenses, and he found it to be nearly as high as *diamond*, and fully twice that of diamond compared with its

density; an observation which re-established and extended the truth of the general principle."

It appears from a variety of observations, that *oily and resinous substances* act most strongly upon light; and as such substances contain a quantity of *hydrogen*, it has been suspected that hydrogen itself exerts a powerful action on light. This is confirmed by experiment, for it is found, that the refractive power of hydrogen is about 6.61436, that is, in round numbers, above six and a half times greater than that of atmospheric air. The specific gravity of hydrogen, according to Davy, is to that of common air, as 732 to 10,000; hence it does not amount to one-thirteenth of the weight of air: the refractive power of the latter, taken at unity, is 1000; that of hydrogen gas being .470, in decimal parts. Now, if the refractive power of hydrogen gas be compared with its specific gravity, the latter being thirteen and a half times less than that of air, it will be found, by multiplying .470 decimal fractions by 13.5 (*i. e.*  $13\frac{1}{2}$ ) that the product will be 6.345; therefore, the refractive power of hydrogen gas, in proportion to its specific gravity, is above six times and one-third greater than that of common air; and this agrees pretty accurately with its refractive power, ascertained by experiment. What inference then, can we deduce from this accordance! Does it not tend to establish the theory that water is, and has been throughout all time, the origin of atmospheric air, as well as of all the inflammable and decomposable productions of nature? (*See* 103, *b.*)

Let us view the subject, likewise, in connexion with that grandest developement of the prismatic spectrum, the *bow of heaven*. It has been proved as we have seen, by experiments, synthetical as well as analytical, that the elements of water are hydrogen and oxygen, in the proportions of about eleven parts of the former, to eighty-nine parts of the latter: now, as the rainbow is produced by the refractive and reflective powers of water, it appears to afford analogical evidence, that all those substances which possess refractive powers, have likewise been produced originally from water; and that the different refractive powers which they exhibit depend upon a peculiar and specific arrangement of the elements of water. It may be objected, that metals, and other substances abounding with carbon, possess a refractive power: I admit it, provided the opacity of such substances be removed by chemical agency; but what then? the *metals* and *carbon* may both have an aqueous origin!—(*See* 103.) Oxygen gas possesses a power of refraction somewhat less than that of atmospheric air; here then, we may trace another proof of the aqueous source of atmospheric

air; for, the superior refractive power of that gaseous compound, will thus be found to depend altogether upon the portion of hydrogen gas which enters into its composition.

The following table will exhibit the specific gravity and refractive power of five of the gases, by a comparison of which, some idea may be formed of the relation that subsists between the one and the other. It should, however, be remembered, that when gases or fluids combine *chemically*, the density of the new compound is generally different from the *mean* density of the constituent; consequently, the specific gravity and refractive power of such new compound, cannot be determined, accurately, by a calculation founded upon a comparison of the mean density of its constituents, and of the definite proportions in which they are therein combined.

TABLE OF SPECIFIC GRAVITIES.

As by	Atmosph. Air.	Oxygen Gas.	Hydrog. Gas.	Azote.	Ammonia- cal Gas.
Dr. Henry. . . . .	1·000	1·103	·084	·985	·585
Sir Humphry Davy . .	1·000	1·096 +	·073 +	·951 +	·580
Treatise on Hydrostatics.	1·000	1·111	·069	·972	·590
Average of the three . .	1·000	1·103	·0753 +	·9693 +	·585

TABLE OF REFRACTIVE POWERS.

As by	Ditto.	Ditto.	Ditto.	Ditto.	Ditto.
M. Dulong, the Treatise on Optics . . . . .	1·000	·924	·470	·1020	·1309

The *Treatises* alluded to, are those on **HYDROSTATICS**, and **OPTICS**, of *The Library of Useful Knowledge*, see page 20 of the former, and page 6 of the latter.

178. *Deoxidating power of the Spectrum*.—"In the year 1801, the late Mr. Ritter, of Jena, discovered that the rays of the spectrum had different chemical properties which resided in the violet end of the spectrum, and existed even beyond the violet light. Muriate of silver, for example, became black beyond the violet rays, a little less black in the violet; and still less in the blue. Dr. Wollaston made the same discovery about the same time. In repeating these experiments, Dr. Seebeck found, that the colour of muriate of silver varied with the coloured spaces in which it was placed. In and beyond the violet, it was reddish brown; in the blue, it was blue, or blueish grey; in the yellow, it was unchanged white, or faintly

tinged with yellow, and in the red, it was red. With prisms of flint glass, the muriate of silver also became red at a spot entirely beyond the red."—(*Treatise on Optics*, 29.)

It may be useful to inquire, what is to be understood by the terms "deoxidating" and deoxidizing." When any substance, a metal, for example, becomes oxidized, it loses its metallic lustre, is generally reduced to the form of a powder, and acquires weight: in this altered state, the new substance is called an *oxide*, that is to say, it has become chemically united with a certain portion of the base of oxygen gas, obtained either, 1st, by electro-chemical attraction of the oxygen of the atmosphere, (that is, with that portion of it which exists in excess, the neutral oxide, or *nitrogen* remaining undecomposed—No. 141); 2nd, by the decomposition of water, the metal attracting the oxygen, and liberating the hydrogen in the form of gas, (*see* 94); or, 3rd, by the decomposition of some acid or other chemical agent, containing oxygen; in which process, the metal seizes upon the oxygen by divellent or separating attraction. Now, *de-oxidation*, the reverse of these processes, is neither more nor less than the electro-chemical attraction exerted by some agent, which, depriving the metal of a portion, or of the whole of its oxygen, proportionably "reduces," or restores the metal; and either combines with the oxygen, or sets it at liberty in the form of gas. When *light* is the deoxidizing agent, there can be little doubt that it combines electrically with the base of the oxygen, and converts it into gas. Does not this property of light tend to confirm the theory of the electrizing principle of the sun's rays?

179. *Magnetizing power of the solar rays.*—"Nearly twenty years ago, Dr. Morichini, of Rome, found that the violet rays of the spectrum, had the property of communicating magnetism; but this result was involved in doubt, and by many philosophers entirely discredited, till it was established by some recent experiments of Mrs. Somerville. Having covered half of a sewing needle, about an inch long, with paper, she exposed the other half for two hours, to the *violet* rays. The needle then acquired north polarity. The indigo rays produced nearly the same effect; and the blue and green rays produced it in a still less degree. In the yellow, orange, red, and invisible rays, no magnetic influence was exhibited, even though the experiment was continued for three successive days. The same effects were produced by enclosing the needle in blue or green glass, or wrapping it in blue and green ribbons, one half of the needle being always covered with paper."—(*Id.* 29.)

The magnetizing property of the blue rays has already been noticed at Nos. 58 and 66; the foregoing quotation contains some

novel particulars, of a very interesting nature; but it is to be lamented, that philanthropic persons, whose aim it is to diffuse elementary instruction, should ever fail to render their communications quite intelligible. In the present instance, it is not possible for any one who reads the *Treatise on Optics*, to discover, whether the needle enclosed in blue and green glass, or silk ribbons, will acquire magnetism, by being so enclosed; or whether it be still necessary to expose it, and its envelopes, to the blue ray of the spectrum: the latter may doubtless be inferred, but the inference is not inevitable. Elementary information can only be effectually conveyed, when every particular communicated, is rendered perfectly free from ambiguity or doubt.

180. *Phenomena of Light, and Effects on Vegetation.*—In *The Mechanics' Register* of Dec. 10, 1825, it is stated that an experiment was made by Mr. Henry Phillips, to show the different effects of natural and artificial light on plants. He selected three species of *mimosa*, or sensitive plant; the *elegans*, *nova*, and *decurrens*, whilst their leaves were fully expanded. On placing them in a dark room, the leaves immediately collapsed, as the feathers of a bird's wing fold over each other. The strongest *artificial* light that could now be thrown on them, had no effect on the automatic motion of the plants, and the foliage remained in a collapsed state, until they were removed into the natural light of day, when their sensitive properties immediately became perceptible, and the whole of the leaflets were seen moving towards their natural direction.

“That light has a very powerful effect upon plants has long been known, independent of the remarks of Hales and Ingenhousz. The green colour of the leaves is owing to it, insomuch that plants raised in darkness are of a sickly white. It has even been observed that when light is admitted to the leaves through different glasses, each tinged of a different prismatic colour, the plant is paler in proportion as the glass approaches nearer to violet. The common practice of blanching celery in gardens by covering it up from the light, is an experiment under the eyes of every one.

“Light acts beneficially upon the upper surface of leaves, and hurtfully upon the under side; hence the former is always turned to the light, in whatever situation the plant may happen to be placed. Trees, nailed against a north wall, turn their leaves from the wall, though it be towards the north, and in direct opposition to those on the southern wall, over against them. Plants, in a hot-house all present the fronts of their leaves, and this influences even the posture of the branches, to the side where there is most light, but neither to the quarter where most air is admitted, nor to the fire in

search of heat. If the branches of a trained tree in full leaf, be disturbed in their position, the leaves resume their original direction in the course of a day or two. The brighter the day, the more quickly is this accomplished. If the experiment be often repeated, they continue to turn, but more weakly, and are much injured by the exertion.

“Mr. Calandrini found vine-leaves turned to the light when separated from the stem, and suspended by a thread. Of this, any one may be easily satisfied, provided the experiment be made with sufficient care and delicacy.—Nor is this effect of light peculiar to leaves alone. Many flowers are equally sensible to it, especially the compound radiated ones, as the daisy, sun-flower, marigold, &c. In their forms nature seems to have delighted to imitate the radiant luminary to which they are apparently dedicated, and in the absence of whose beams many of them do not expand their blossoms at all. The stately annual sun-flower, *helianthus annuus*, displays this phenomenon more conspicuously on account of its size, but many of the tribe have greater sensibility to light. There can be no doubt from the observation of other similar flowers, that the impression is made on their radiated florets, which act as wings, and seem contrived chiefly for that purpose, being frequently destitute of any other use.

“A great number of leaves likewise follow the sun in its course: a clover-field is a familiar instance of this.

“Of all leaves, those of the pinnated leguminous plants are found most affected by light, insomuch that it appears, in several cases, the sole cause of their expansion, for when it is withdrawn, they fold over each other, or droop, as if dying; and this is called by Linnæus, the sleep of plants, who has a dissertation on the subject, in his *Amœnitates Academicæ*.”—(*Smith's Introduction*, chap. xvi., 207 to 210, *Functions of Leaves*.)

The most remarkable case of the expansion of flowers during the light of day, is exemplified in the *lotus*, discovered by Theophrastus, (A. C. 300,) which, according to Dr. Smith, appears to be the *Nymphaea Lotus* of Linnæus. “This,” says Theophrastus, “as well as the *cyamus*, bears its fruit in a head. The flower is white, consisting of many crowded leaves, about as broad as those of a lily. These leaves, at sunset, fold themselves together, covering the head (or seed vessel); at sunrise, they expand, and rise above the water. This they continue to do till the head is perfected, and the flowers fall off.”—“So far,” says Dr. Smith, “Theophrastus writes as of his own knowledge; he continues as follows:—‘It is reported that, in the Euphrates, the head and flowers keep sinking till midnight, when

they are so deep in the water. as to be out of reach of the hand, but towards morning, they return, and still more, as the day advances. At sunrise, they are already above the surface, with the flower expanded; afterwards, they rise high above the water.' Pliny repeats the same account; and Prosper Alpinus—whose purpose is to prove the *lotus* of Theophrastus not different from the common *nymphaea* (white water lily), in which, as far as *genus* is concerned, he is correct—has the following remarkable passage:—  
'The celebrated stories of the *lotus* turning to the sun, closing its flowers, and sinking under water at night, and rising again in the morning, are conformable to what every body has observed in the *nymphaea*.'

"I have been the more particular in the above quotations," continues Dr. Smith, "because the veracity of Theophrastus has lately been somewhat rudely impeached on very questionable authority. For my own part, I think what we see of *nymphaea* in England, is sufficient to render the above account highly probable in a country where the sun has so much more power, even if it did not come from the most faithful and philosophical botanist of antiquity."—(*Idem. Nymphaea*, p. 333.)

If the reader compare these most interesting quotations with the facts referred to at Nos. 62 and 63, on the influence of the sun's rays upon vegetation; if, above all, he carefully observe the phenomena which every field and garden affords, he will scarcely fail to be convinced of the truth of the remark of Sir Humphry Davy—that "it is certain the rays exercise an influence independent of the heat they produce." This influence appears to me to be of an electrical nature, exerted through the media of the *points* of conduction, with which almost every part of the flowers and leaves abound; the pointed terminations of the flower conducting the fluid which stimulates the organs of fructification, while those of the leaves introduce that which tends to perfect the processes of respiration, glandular secretion, and elaboration of the proper juices.

If these views be correct, and if *the vital functions of the leaves be excited, and brought into activity by the agency of LIGHT, and of ATMOSPHERIC AIR*, then it follows, that in the acts of training and pruning trees, the gardener ought to endeavour to expose the greatest possible surface of the leaves to the direct operation of the solar beams. He will effect this, by spreading the branches of his *all* trees, somewhat widely apart, and by removing those boughs of his *standard* trees, which interlace and entangle others, that promise to be most productive of blossoms. Every fruitful branch—even to the very centre of the tree—ought to be laid open, so as to enjoy a full *solar exposure*, as well as the free access of the air. The direct ray

is the chief agent in the perfect laboration of the *fertilizing* sap; the *air* is a fluid whose constituents are perhaps, held in union by their specific electricities, produced by the influence of *solar light*; and hence *air* may be deemed a vehicle of that light, though in a state of peculiar modification.

The vital importance, therefore, of a perfect exposure of the leaves to the influence of these two paramount agents, must be apparent to every one who has attentively observed the various phenomena of growth and fructification. The former—that is, the extension of the shoots, is not inconsistent with a state of darkness, provided a certain degree of heat be present; but the maturity of those shoots, and the production of blossoms and fruit, are generally induced by the agency of *light*, or more properly speaking—of the *direct rays of the sun*. The subject will be resumed, when I come to speak of the operations of *training*, &c.

181. *Influence of Light in producing Oxygen*.—"Plants exposed to light," says Sir Humphry Davy, "have been found to produce oxygen gas, in an elastic medium and in water, containing no carbonic acid gas; but in quantities much smaller than when carbonic acid gas was present. In the dark, no oxygen gas is produced by plants, whatever be the elastic medium to which they are exposed. In most cases, on the contrary, oxygen gas, if it be present, is absorbed, and carbonic acid is produced."—(*Agric. Chem.* p. 204.)

182. *Influence of Light on the Leaves of Plants*.—"It frequently happens in America, that clouds and rain obscure the atmosphere for several days together, and that, during this time, buds of entire forests expand themselves into leaves. These leaves assume a pallid hue till the sun appears, when, within the short period of six hours of a clear sky and bright sunshine, their colour is changed to a beautiful green."

One of the most interesting proofs of the attractive energy of solar light is founded in the ternate leaves of *Erythrina cristogalli*, and *laurifolia*: at mid-day, when the sun is high, they appear as if they would rush to the zenith, impatient of control: at night they are reversed. Each leaf and leaflet is furnished with a beautiful elastic piece of mechanism by aid of which its movements are facilitated.

A writer in SILLIMAN'S *Journal* mentions a forest on which the sun had not shone during twenty days. The leaves during this period had expanded to their full size, but were almost white. One forenoon the sun began to shine in full brightness, "the colour of the forest absolutely changed so fast, that we could perceive its progress. By the middle of the afternoon the whole of these extensive

forests, many miles in length, presented their usual summer dress.”  
—(*Mag. Nat. Hist.* Vol. I.—from SILLIMAN'S *Journal*.)

183. *Influence of Light upon Fruit*.—“When apples are gathered, they should be laid upon cloths or mats in the sun, or in some dry place, until they become perfectly dry in every part of them. When there is a frost, all that you have to do is to keep the apples in a state of total darkness, until some days after a complete thaw has come. In America they are frequently frozen as hard as stones; if they thaw in the *light*, they rot; but if they thaw in darkness, they not only do not rot, but lose very little of their original flavour. This may be new to the English reader; but he may depend upon it that the statement is correct.”—(*English Gardener*, No. 261.)

To this may be added, that I have seen reason to believe that if *medlars* be preserved in total darkness, they are some weeks longer in attaining to maturity than when they are exposed to the light.

184. To sum up this inquiry into the nature and properties of light, I observe that we are assured, by the testimony of our organs of vision, that light—*white light*, as it is termed—is transmitted to us in the solar beams. The experiments of Newton, and of other philosophers, have led to the inference that light is actually *composed* of seven different colours; but when it is considered that the spaces occupied by the colours of the spectra, produced by different substances, vary much in extent; that the spectrum from a prism of *oil of cassia* “will be two or three times longer than that of the glass prism;” that the least refrangible colours, *red*, *orange*, and *yellow*, will occupy less spaces, or will be more contracted in a spectrum from oil of cassia, than in one produced by *sulphuric acid*; “that different bodies possess very different powers of *dispersing* or of separating the coloured rays of light;” again, that, besides these anomalous prismatic phenomena, an endless variety of tints is produced by the processes of vegetable and artificial chemistry;—when these, and many other facts are carefully investigated, I think it will be found more safe to conclude, that the sun's rays contain a certain *principle*, by the operation of which colours are produced and developed; than that “the white light which comes from the sun, or from any other luminous body, is actually composed and made up of seven different kinds of light of different colours,” and of such only.

We have seen that *magnetic* powers are communicated to needles, and small particles of steel, by the blue rays. The close analogy which may be traced between electricity and magnetism, might almost warrant the conjecture, that *light* and magnetism,

when under certain modifications within the earth's surface, constitute electric or elementary fire, were it not for two considerations—first, that *magnetism* is produced when concentrated electricity passes through space, its sphere of action being at right angles to the course of the electricity:—thus a bar of steel, placed transversely over a wire conveying an electrical shock, becomes a magnet; second, that magnetism exerts its energy chiefly on iron, nickle, and some other metallic substances.

These facts, and several other natural phenomena, lead to the hypothesis that the central zone of the earth, the belt included between the tropics, is the fountain and wide field of solar electricity, and that the poles of the earth are the sources of *magnetism*. The electric and magnetic streams circulate in transverse directions, and induce the phenomena of heat and cold, wind and storm; in a word, all those atmospheric disturbances which have been ascribed to positive and negative electricity.

Murphy's theory of the weather is based upon conjoint or opposed electric and magnetic energy: and so far it claims respectful attention, and the profoundest investigation.

185. *Theory of Light*.—After mature consideration of facts and deductions, I am inclined to define SOLAR LIGHT, *as a material fluid—in its nature the most subtile, penetrating, and energetic—the source of all the phenomena of HEAT, ELECTRICITY, and MAGNETISM, (see 66).* In all probability light itself is in its nature subject to decomposition; it at least exerts an inductive energy, by which it effects the most astonishing electro-chemical changes.

The direct influence which light exerts upon vegetable organized beings, appears to effect the induction of those electrical currents which regulate the flow of the sap, the laboration of the proper juice, and compound secretions, and the separation and fixation of the colouring principle, be it "*chlorophyll*," or what else.

On the organs of *fructification* it acts with peculiar energy, producing those surprising modifications in the vascular system, which take place during the maturation of the seed and fruit. "Organization, sensation, spontaneous motion, and all the operations of life," says Lavoisier, "only exist at the surface of the earth, and exposed to the influence of light; without it, nature itself would be lifeless and inanimate. By means of light, the benevolence of the Deity hath filled the surface of the earth with organization, sensation, and intelligence. The fable of Prometheus might perhaps be considered as giving a hint of this philosophical truth, which had even presented itself to the knowledge of the ancients."

## PART II.

## HEAT.

181. **W**HATEVER be the real nature of heat, it may be said of it, as of *light*, that what we know of this agent, we know by its effects: we perceive its influence in the developement and growth of vegetation—we witness its energy in the phenomena of expansion—for solids, fluids, and gases, expand more or less on becoming heated; but our ignorance of the *cause* of heat is rendered evident by the mysterious and contradictory hypotheses of those who have made it a subject of investigation. The inquiry is indeed involved in doubt and intricacy; it is a fortunate circumstance, however, that, in as much as concerns the science of gardening, all the phenomena of heat may be considered as *effects* resulting from the operation of one or more of those natural agents which already have come under notice. Instead, therefore, of giving a detailed account of the various theories that have been promulgated, I shall restrict myself to a few abbreviated extracts from the works of modern philosophers, commencing with a quotation from the *Elements* of LAVOISIER. (Vol. i. p. 52.)

That great chemist believed heat to be a *material substance*; for after attentively considering the phenomena of attraction and repulsion, he adds, “It is difficult to comprehend these phenomena without admitting them as the effects of a real material substance, or very subtile fluid, which, insinuating itself between the particles of bodies, separates them from each other.”

To this substance, “in the *Memoir* published in 1777, I gave the name of *igneous fluid*, and *matter of heat*: and since that time, in the work published by MM. de Morveau, Berthollet, de Fourcroy, and myself, upon the reformation of the chemical nomenclature, we thought it necessary to reject all periphrastic expressions: wherefore, we have distinguished the *cause* of heat, or that exquisitely elastic fluid which produces it, by the term *caloric*.”

187.—Sir Humphry Davy does not appear to admit the materiality of heat, or to consider it as a specific fluid. “It seems possible to account for all the phenomena of heat, if it be conceived that in solids the particles are in a constant state of vibratory motion; the particles of the hottest bodies, moving with the greatest velocity, and through the greatest space; that in fluids and elastic fluids, besides the vibratory motion, which must be conceived greatest in the last, the particles have a motion round their own

axes, with different velocities, the particles of elastic fluids moving with the greatest quickness; and that in ethereal substances, the particles move round their own axes, and separate from each other, penetrating in right lines through space."

188.—"The facility," says Dr. Young, "with which the mind conceives the existence of an independent substance, liable to no material variations, except those of its quantity and distribution, especially when an appropriate name, and a place in the order of the simplest elements has been bestowed on it, appears to have caused the most eminent chemical philosophers to overlook some insuperable difficulties attending the hypothesis of caloric."—"The circumstances which have already been stated respecting the production of heat by friction, appear to afford an unanswerable confutation of the whole of this doctrine. If the heat is neither received from the surrounding bodies, which it cannot be without a *depression* of their temperature; nor derived from the quantity already accumulated in the bodies themselves, which it could not be, even if their capacities were diminished in any imaginable degree; there is no alternative but to allow that heat must be actually generated by friction; and if it is generated out of nothing, it cannot be matter, nor even an immaterial or semi-material substance."—Having drawn a parallel between the production of heat and sound, and observing that analogies are favourable to the vibratory hypothesis, Dr. Young adds:—"Those, however, who look up with unqualified reverence to the dogmas of the modern schools of chemistry, will, probably, long retain a partiality for the convenient, but superficial and inaccurate, modes of reasoning, which have been founded on the favourite hypothesis of the existence of caloric as a separate substance;" &c.—(From *Treatise on Heat, of the Library of Useful Knowledge*, page 6.)

189.—"Caloric," observes Parkes, "is the name which modern chemists have given to fire, or the matter of heat, a large portion of which is intimately combined with the atmosphere."—"There are six sources from whence we procure caloric; viz., from the sun's rays, by combustion, by percussion, by friction, by the mixture of different substances, and by means of electricity and galvanism. The sun is the chief fountain which furnishes the earth with a regular supply, and renders it capable of supporting the animal and vegetable creations."—"It is now a prevailing opinion, that the sun is not the original source of heat, but that the earth, and each planet belonging to the system, is furnished with the necessary portion of caloric, and that the rays of the sun impinging upon the earth, and the other planetary bodies, elicit the native caloric which

is inherent in them, and occasion what is called heat." (*Rudimenta*, Nos. 50—60, and note.)

190. *Theory of Latent Heat*.—By the term latent heat, is to be understood that portion of *caloric*, or the matter of heat, which is supposed to remain dormant or concealed in matter, and which cannot be discovered by instruments, nor by the touch, or sense of feeling. The hypothesis claims Dr. Black as its author, whose first decisive experiment, as it is considered, was made in December 1761, at Glasgow. "It consisted in comparing the length of time which a given weight of water required to raise its temperature one degree, with the length of time which the same weight of ice required for its liquefaction, an equal heat being applied in both cases; and, also, reversing the experiment, he compared the length of time required to depress the temperature of a given weight of water one degree, with the length of time required to freeze the same quantity. He was thus enabled to determine, that the quantity of heat necessary to enable a given weight of ice to assume the fluid form, is equal to that which would raise the temperature of water  $140^{\circ}$ ."

Other experiments of a like description, all tending to elucidate the theory, are worthy of being noticed.

(1.) "Mix equal weights of ice at  $32^{\circ}$ , and water at  $212^{\circ}$ , the resulting temperature will be  $52^{\circ}$ , thus the water loses  $160^{\circ}$ ." Now as the mean temperature of the two, *i. e.*  $212 + 32 \div 2 = 122^{\circ}$ , it is evident that  $70^{\circ}$  of heat have been lost by the liquefaction of a weight of ice, equal to that of the water; or, by another method of calculation, double that quantity of heat has become absorbed and latent; for as the water loses  $160^{\circ}$ , *i. e.*  $212 - 52^{\circ}$ , and as the ice gains but  $20^{\circ}$ , *i. e.*  $32 + 20 = 52^{\circ}$ , it would appear that  $140^{\circ}$  have vanished;  $20^{\circ}$ , — the temperature gained by the ice, being subtracted from  $160^{\circ}$ , the temperature lost by the water, leaving  $140^{\circ}$ , as above."

(2.) "If water be cooled to  $22^{\circ}$ , and then, by agitation or otherwise, be made to freeze, a fourteenth part of the whole will be frozen, and the temperature will rise to  $32^{\circ}$ ; here the water that freezes gives out its latent heat, *viz.*  $140^{\circ}$ , which, being divided among the fourteen parts, raises the temperature of each  $10^{\circ}$ , that is, from  $22^{\circ}$  to  $32^{\circ}$ ."

(3.) "If ice and water of the same temperature be placed equidistant from fire, the ice will be melted into water at  $32^{\circ}$ , in precisely the same time that the water requires to attain the temperature of  $172^{\circ}$ ; and  $172 - 32 = 140^{\circ}$ , as before."

Connected with the above, there are other facts which by some

may be considered as tending to establish the theory of latent heat. I extract the following quotation from the *Treatise on Heat*, of the *Library of Useful Knowledge*; observing, that if the experiments therein detailed be minutely weighed, and compared with those whereon the theory is more immediately grounded—some of which have been detailed above—they will, I think, be found to throw a shade of doubt upon that hypothesis, which heretofore has been received with almost unhesitating credence.

191. “*Ice cannot be raised higher than the temperature of 32° without melting; but water may, under certain circumstances, be cooled much lower without freezing. Mr. Dalton succeeded in reducing it to 5° of Fahrenheit before it solidified. Agitation is unfavourable to this experiment, occasioning the water to freeze instantly, and its temperature to rise to the freezing-point. It was proved by Dr. Black that water which has been deprived of air by boiling, freezes more readily than unboiled water, on account, as he supposed, of a slight agitation upon its surface, occasioned by the attraction of air. Whatever particles impair the transparency of water, when mixed with it, produce the same effect; but the most effectual method of determining the congelation of water which is colder than the freezing-point, is to introduce a particle of ice or snow: crystallization instantly commences. Sir Charles Blagden exposed to the atmosphere two vessels containing distilled water, when the temperature was about 20° and the day calm; one of the vessels he covered slightly with paper; the other, being left uncovered, the temperature of the water in the covered vessel sunk many degrees below 32° without freezing, while ice invariably formed upon the surface of the other vessel, before a thermometer immersed in it was cooled quite to the freezing-point. This difference he accounted for on the supposition, that the frozen particles which float in the air, at that temperature, being permitted to come into contact with the water in the uncovered vessel, occasioned the process of congelation to commence. The effect of oil poured upon the surface of water in preventing it from freezing, may be ascribed to the same cause.*” (*Treatise*, page 43.)

I would suggest the inquiry, whether heat be not a conventional term for an effect produced by electro-chemical agencies: whether all the phenomena of increase in temperature, of combustion, and of inflammation, on the one hand; and of refrigeration and freezing on the other, may not be produced solely by an exchange, or alteration of electric relations? Freezing, though co-incident with cold, does not wholly depend upon it, as has been seen above; it appears to

result from some act implying friction, concussion, or attraction ; and then, is attended with an increase of heat ! Can an increase, one really determinable as such by the thermometer, be occasioned by the *escape* of caloric ? Should we not be inc lined, were it not for the weight of authority, and the sanction of theory, to ascribe that increase of temperature to the acquisition, or reception, rather than to the loss of heat ? That which has been said on the subject of combustion, by Dr. Ure, appears to be equally applicable to the theory of heat ; it is in substance as follows :—“ The evolution of heat is not to be ascribed simply to gas parting with its *latent* store of that ethereal fluid, or to its fixation or combustion. No peculiar substance or form of matter is necessary for producing the effect ; *it is a general result of the action of any substances possessed of strong chemical attractions, or different electric relations ;* and it takes place in all cases in which an intense and violent motion can be conceived to be communicable to the corpuscles of bodies.” As this principle or axiom appears to be very comprehensive, I would endeavour to corroborate, as well as to interpret it, by referring to the principles of electro-chemical action laid down at No. 102 ; and also to the paragraph on *Ice and Snow*, No. 105, page 110.

192. *Heating Power of the Prismatic Spectrum.*—If the reader refer to No. 176 of the present section, he will perceive the order and arrangement of the colours produced by the decomposition of the solar rays of light ; of these, the yellow, or central ray, is the most luminous ; and consequently might be supposed to possess the greatest heating power. “ Dr. Herschel, however, found that the heat increased from the violet to the red end, the heat of the orange being greater than that of the yellow ; and the heat of the red being greater than that of the other colours ; but upon placing his thermometer beyond the red rays, and in the dark, he was surprised to observe that the mercury still rose ; and upon repeating this experiment under a variety of circumstances, he established the remarkable fact, that the heat was the greatest at a point beyond the red extremity of the spectrum, and at a spot upon which none of the luminous rays at all fell. Hence he concluded, that *there were invisible rays in the sun’s light which had the power of producing heat, and which had a less refrangibility than red light.* This result was confirmed by Sir. H. Englefield, and also by Sir Humphry Davy, who repeated the experiments in the rays of an Italian sun ; and by means of thermometers with minute bulbs, Sir H. Englefield obtained the following results :—

Blue	.	.	.	.	56°	temperature.
Green	.	.	.	.	58	do.
Yellow	.	.	.	.	62	do.
Red	.	.	.	.	72	do.
Beyond red	.	.	.	.	79	do.

The prisms by which all these experiments were made, were, we believe, of flint glass. It has been recently proved by M. Seebeck, (*Edinburgh Journal of Science*, No. I. 358,) that the heating power of the colours of the spectrum depend upon the *substance* of which the prism is made. Thus:—

In water, the greatest heat is in the	.	.	.	.	yellow.
Sulphuric acid, solutions of muriate of ammonia, and corrosive sublimate	.	.	.	.	} orange.
Crown or plate glass	.	.	.	.	
Flint glass	.	.	.	.	beyond the red *."

These variations in the position of the heating rays, might authorize the suspicion, that there must be something in the composition of the refracting medium, which effects the developement of both the *coloured image* and the *heat*. I suspect that both the one and the other are results of electro-chemical decompositions; as it is also probable, the developement of the *electric fluid*, by friction of silk upon glass, will be found to be. Where all is wonder, the mind need not be staggered by the suggestion, that the refracting medium may act *chemically* upon the sun's rays, and produce the double phenomena of coloured and heating rays, varying in position, or extent, according to the nature of the medium through which they pass.

*Light and heat* exert a mutual energy over each other, but they appear also to act independently. On this subject the following quotation will not be uninteresting. The *lunar rays* produce no heat however they may be concentrated.

“De la Hire collected the rays of the full moon when in the meridian, by a lens thirty-five inches in diameter, and threw them upon the bulb of a very sensible air thermometer, but they produced no effect, though they were thus concentrated 306 times.

“It is not however surprising, that the moon-beam should be thus inefficient, when we consider the extreme feebleness of its illuminating power, as compared with the solar ray of the same size; the light of the latter being at least 300,000 times greater than the former. It appears probable, therefore, that the properties of the moon-beam are to be referred to its *feebleness*, as compared

\* See *Treatise on Optics, Lib. of Useful Knowledge*, p. 28; and Dr. HUTTON'S *Mathematical Dictionary*, art. 'Sun.'

with that of the sun; though there may be some peculiarity in its nature, or some power in the surface of the moon of *retaining* the heat, whilst it emits the light received from the sun. It is possible even that the moon may *radiate cold*."—BRANDE'S *Manual of Chemistry*, 1836, p. 204.

If philosophers thus indulge in speculative ideas, might it not be permitted to suggest that *magnetism* may be reflected from the moon? Would not this accord with the phenomena of the moon's influence on the tides, and also with the new theory that magnetism is the origin of *cold*?

193. *Of the Radiation of Heat, as connected with the phenomenon of Dew*.—Dew is described as "the moisture insensibly deposited from the atmosphere on the surface of the earth. This moisture is precipitated by the cold of the body on which it appears, and will be more or less abundant, not in proportion to the coldness of that body, but in proportion to the existing state of the air in regard to moisture. It is commonly supposed that the formation of dew produces cold, but like every other precipitation of water from the atmosphere, it must evidently produce heat. In the *Encyc. of Gard.*, No. 1198, we read that, "*Heat is radiated by the sun to the earth, and if suffered to accumulate,*" Dr. Wells observes, "would quickly destroy the present constitution of the globe. This evil is prevented by the radiation of heat from the earth to the heavens, during the night, when it receives from them little or no heat in return. But, through the wise economy of means, which is witnessed in all the operations of nature, the prevention of this evil is made the source of great positive good. For the surface of the earth, having thus become colder than the neighbouring air, condenses a part of the watery vapour of the atmosphere into dew, the utility of which is too manifest to require elucidation. This fluid appears chiefly where it is most wanted, on herbage and low plants, avoiding, in a great measure, rocks, bare earth, and considerable masses of water. Its production, too, tends to prevent the injury that might arise from its own cause; since the precipitation of water upon the tender parts of plants, must lessen the cold in them which occasions it."

There is something very mysterious and perplexing in this theory of the deposition of dew, in consequence of cold, produced by the radiation of heat; and also in the choice or discrimination of appropriate situation, which the dew evinces. The decrease in temperature can scarcely be reconciled with the fact, that bodies possessed of a certain degree of temperature, tend strongly to produce an equilibrium with other bodies possessing a different degree of temperature: thus if a gallon of boiling water be poured into a

vessel containing a gallon, or other portion of cold water, the heat of the former will be distributed throughout the whole bulk of water, and the temperature, though changed, will be equalized. Again, if a heated solid body be plunged into cold water, the heat will be radiated or distributed throughout the water, until the temperatures of the solid and fluid become equal; that is, until the equilibrium be established; but there it will stop: the heated body will not, while in contact with the water, become *colder than that fluid*; nor will radiation, in the common acceptation of the term, ever produce an effect so extraordinary!

Again, at No. 1244, *On the Phenomenon of the Dew*, we find, “that dew appears only on calm and clear nights. Dr. Wells shows, that very little is ever deposited in opposite circumstances, and *that little* only when clouds are very high. It is never seen in nights both cloudy and windy; and if, in the course of the night, the weather, from being serene, should become dark and stormy, *dew which had been deposited will disappear.*” “A clear morning, following a cloudy night, determines a plentiful deposition of the retained vapour. When warmth of atmosphere is compatible with clearness, as is the case in southern latitudes, though seldom in our country, the dew becomes much more copious, because the air then contains much more moisture. Dew continues to form with increased copiousness as the night advances, from the increased refrigeration of the ground.

194. “*Dense clouds*, near the earth, reflect back the heat they receive from it by radiation. But similarly dense clouds, if very high, though they equally intercept the communication of the earth with the sky, yet being, from their elevated situation, colder than the earth, will radiate to it less heat than they receive from it, and may, consequently, admit of bodies on its surface becoming several degrees colder than the air.” “The manner in which clouds prevent, or occasion to be small, the appearance of cold at night, upon the surface of the earth, is by radiating heat to the earth, in return for that which they intercept in its progress from the earth towards the heavens. For, although upon the sky becoming suddenly cloudy during a calm night, a naked thermometer, suspended in the air, commonly rises two or three degrees, little of this rise is to be attributed to the heat evolved by the condensation of watery vapour in the atmosphere, for the heat so extricated must soon be dissipated; whereas the effect of greatly lessening, or preventing altogether, the appearance of a superior cold on the earth to that of the air, will be produced by a cloudy sky, during the whole of a long night.”—*(Idem, 1198.)*

From these, and similar considerations, Dr. Wells, and others, have inferred, and laid down as axioms, that “the formation of dew is the consequence of radiation, that cold is the cause of dew, and not *dew* of *cold*, as many have supposed; and it is always found, during the formation of dew, that the surface of the ground is colder than the superjacent air, owing to its radiation of heat into the atmosphere. The best radiators are soonest dewed; hence, grass and vegetables are more quickly covered with dew than gravel stones or metals; and as the earth dissipates its heat by radiation, it will be seen that any slight awning spread over the ground will prevent radiation, and keep the earth warm.”—PRESTON’S *Third Lecture on Heat*, at the Mechanics’ Institution.

If the reader re-peruse what has been said on the ascent of vapours, and the formation of clouds, at No. 137-8; and then consider it an acknowledged fact, that much more vapour rises during hot weather than during cold; and yet, that in settled, dry, and very hot seasons, so long as the atmospheric electric relations remain undisturbed, the dew is precipitated in very diminished quantities; if, moreover, he inquire upon what grounds it is asserted that grass and herbage are the best radiators, and, consequently, become the soonest dewed, he will begin to waver in his opinion concerning the soundness of the theory, and to suspect that the cause of the phenomenon of dew, and the solution of the difficulties with which it is involved, must be sought for in some agency independent of the radiation of heat.

It must also be borne in mind, in contradiction of the assertion before quoted, namely, that “the fluid appears chiefly where most wanted, on herbage, and low plants;” that, in confirmed drought, with the wind at north, or north-east, the dew fails, and the herbage remains dry. It should seem that the *state* of the grass has much to do in the regulation of the phenomenon: if that be rich, juicy, and verdant, water is abundantly thrown off by what is styled vegetable transpiration; but if through protracted aridity the plant has become weak and flaccid, very little water is thrown off: hence we may conclude that the dew, in a great degree, is produced by growing plants, being the watery particles of their sap exuded from their breathing pores. It is remarkable how very speedily a change of wind to the south-west, with a few showers, will produce dew. The vital principle of the plant is thereby stimulated, and all its functions (which had been as it were paralyzed by a parching sun and wind) are at once resumed.

195. *Cause of the Phenomenon of Dew.*—Dr. Wells, it is said, by a copious induction of facts, derived from observation and

experiment, establishes the proposition that bodies *become colder* than the neighbouring air before they are dewed; and as different bodies project heat with very different degrees of force—"in the operation of this principle, conjoined with the power of a *concave mirror of clouds*, or any other awning, to reflect, or throw down again those calorific emanations which would be dissipated in a clear sky, we shall find a solution of the most mysterious phenomenon of dew."

They who do not possess Dr. WELLS's *Essay*, and who are desirous to investigate and scrutinize the means which have been made use of to ascertain the causes of the phenomenon of dew, will probably be gratified by an abridged account extracted from the "*Encyclopædia of Gardening*," of those experiments and observations which have led to the establishment of the present theory. I shall mark those passages in italics, which contain important facts that promise to throw some light upon the general subject under inquiry, and to lead to deductions very different from those which have been drawn from them.

"After a long period of drought, when the *air* was very *still*, and the *sky serene*, Dr. Wells exposed to the sky, twenty-eight minutes *before sunset*, previously weighed parcels of *wool* and *swansdown*, upon a smooth, unpainted, and perfectly *dry fir table*, five feet long, three broad, and nearly *three in height*, which had been placed an hour before *in the sunshine*, in a large level grass field. The *wool*, twelve minutes after sunset, was found to be  $14^{\circ}$  *colder than the air*, and to have acquired no weight. The *swansdown*, the quantity of which was much greater than that of the wool, was at the same time  $13^{\circ}$  *colder than the air*, and was also *without any additional weight*. In twenty minutes more, the swansdown was  $14\frac{1}{2}^{\circ}$  *colder than the neighbouring air*, and was *still without any increase of its weight*. At the same time the grass was  $15^{\circ}$  *colder than the air four feet above the ground*."—(*Encyc. of Gard.*, No. 1245.)

The facts in this extract which require attention are:—first, the state of the air: it was still, and the sky serene—a state which corresponds sufficiently with that described at No. 138 (on the *Atmosphere*). Second,—the nature of the materials employed: they were wool and swansdown,—both of them *electrics*, and ranking among the worst conductors of heat and electricity; they also were placed upon a fir table, that had been rendered an INSULATING medium and a non-conductor, by the previous drying, as well as by the resinous, electric matter which fir contains. These electrics, these non-conductors, then, are thus insulated at an elevation of three feet above the surface of grass, which becomes  $15^{\circ}$  colder than

a stratum of air at a distance of four feet above the ground, and one foot above the table. Under these circumstances, the swansdown becomes cooled to within  $\frac{1}{2}^{\circ}$  of the grass (which most likely *was* dewed, though it is not so stated), and yet remains dry.

The deduction to be drawn from these facts is, that some *non-conductors do not receive the dew*, although cooled  $14\frac{1}{2}^{\circ}$  below the temperature of the neighbouring air; consequently, that *the precipitation of dew cannot depend solely upon the reduction of temperature*, nor upon atmospheric moisture independent of the agency of vegetable organization.

196. *A very slight covering will exclude much cold.*—"Being desirous," says Dr. Wells, "of acquiring some precise information on this subject, I fixed perpendicularly in the earth of a grass-plot, four small sticks, and over their upper extremities, which were *six inches above the grass*, and formed the corners of a square, the sides of which were two feet long, drew tightly a very thin cambric handkerchief. The temperature of the grass, which was thus sheltered from the sky, was always found higher than that of the neighbouring grass, which was uncovered, if this was colder than the air. One night, when the fully-exposed grass was  $11^{\circ}$  colder than the air, the latter was  $3^{\circ}$  warmer than the sheltered grass; and the same difference existed on another night, when the air was  $14^{\circ}$  warmer than the exposed grass. One reason for the difference, no doubt, was, that the air, which passed from the exposed grass, by which it had been very much cooled, to that under the handkerchief, had deprived the latter of part of its heat; another, that the handkerchief, from being *made much colder than the atmosphere*, by the action of *radiation* of its upper surface to the heavens, *would remit somewhat less heat* to the grass beneath, than what it received from that substance." "A difference in temperature of some magnitude was always observed on still and serene nights, between the bodies sheltered from the sky *by substances touching them*, and similar bodies which were sheltered by a substance *a little above them*."

Dr. Wells found that grass sheltered by a cambric handkerchief, *raised a few inches in the air*, was, on one occasion,  $3^{\circ}$ , and on another  $4^{\circ}$  warmer than a neighbouring piece of grass, *with which the handkerchief was in contact*.

These extracts contain facts of real practical utility; but the philosophy of the reasoning, and of the inferences drawn, is doubtful; the whole of the phenomena are ascribed to the influence of *radiation* acting upwards, and again in a contrary direction, as if by *volition*. This taking of effects for causes, will not, however, prove

of any detriment to the practical utility of the observations, as far as they may be brought to bear on the protection of fruit trees; and it will not be amiss to compare them with the paragraph on the "*protecting of wall fruit*," at No. 86. Article, *Peach*.

197. *Heat from a Covering of Snow*.—Dr. Wells ascribes the benefit derived by vegetation from such a covering, in extremely cold latitudes, to the prevention of radiation, and not to the protection from the access of a more intense degree of cold existing in the atmospheric regions, "while low vegetable productions are prevented, by their covering of snow, from becoming colder than the atmosphere, in consequence of their own radiation, the parts of trees, and tall shrubs, which rise above the snow, are little affected by cold from this cause; for their outermost twigs, now that they are destitute of leaves, are much smaller than the thermometers suspended by me in the air, which in this situation seldom became more than 2° colder than the atmosphere."

The larger branches, too, which, if fully exposed to the sky, would become colder than the extreme parts, are, in a great degree, sheltered by them; and, in the last place, the trunks are sheltered, both by the smaller and larger parts, not to mention that the trunks must derive heat by conduction through the roots from the earth, kept warm by the snow.—(From *Essay on Dew*,—See *Encyc. of Gard.*, No. 1204, 5, and 7.)

That radiation may take place from a heated surface into a cooler medium, no one can well doubt; a basin, or wide-mouth glass vessel inverted, will receive moisture from the surface of the ground, and exhibit it in a condensed state; but it will equally receive it from dry, sandy, unclothed ground, as from a surface covered with herbage; radiation so considered, would be little else than another term for evaporation—a process which implies the decomposition of water, and its conversion into vapour. The radiation alluded to is, it should appear, supposed to be produced by the agency of vegetable organized beings, and to result from a faculty which they possess of conducting or carrying off heat from the surface of the earth, and propelling it from their extremities, into the aerial medium with which they are surrounded. But have not the advocates of this theory of radiation overlooked, or lost sight of, the peculiar structure of vegetable bodies, and of all those electromagnetic agencies which are in constant operation throughout the elements of nature?

In allusion to Dr. Wells' remark upon trees, their vital power, and with it, that degree of heat which is essential to their preservation, remain unascertained: whether evergreens are worse conductors

than deciduous shrubs and trees, may not be determinable, but certain it is, that by the severe frost of January, 1838, when, on the 20th, the mercury fell to  $2^{\circ}$ , and in places to  $6^{\circ}$  below zero, the *Laurustinus*, *Bay*, *Arbutus*, and some laurels, received much more serious injury than any deciduous tree or shrub that came under my observation.

If the reader review what has been said at No. 54, and compare it with the foregoing quotations, he must perceive that vegetables are, indeed, most important instruments of conduction, and that they are constantly employed in regulating the state of atmospheric electricity. If he investigate the structure and uses of all those pointed terminations of the leaves and their serratures: of the divisions of the corollas and calyces of flowers; of the thorns, prickles, and bristles of every description; he may find ample cause for believing that they are all destined to perform very important offices connected with vegetable vitality; and thus, *he, too*, may be “led from a copious induction of facts, derived from observation and experiment,” to conclude, that vegetable bodies of all descriptions, grass, herbage, shrubs, and trees, those “*best of radiators*,” which are “the soonest *deiced*,” constitute, in fact, an assemblage of so many conducting points, that they are not only the best conductors of electricity, but dependant upon its agency, under one modification or another, for the propulsion, laboration, and distribution of their own vital and secreted fluids.—(See Nos. 61, 62, and 63.)

198. It will now be interesting to compare what has been quoted, with a short extract from the *Natural History of Selborne*, by that observant naturalist, Mr. White, on the attraction of trees.

“In heavy fogs, on elevated situations especially, trees are perfect alembics; and no one that has not attended to such matters can imagine how much water one tree will distil in a night’s time, by condensing the vapour which trickles down the twigs and boughs, so as to make the ground below quite in a float. In *Newton-lane*, in October, 1775, on a misty day, a particular oak, in leaf, dropped so fast, that the cart-way stood in puddles, and the ruts ran with water, though the ground in general was dusty.”

“Trees perspire profusely, condense largely, and check evaporation so much, that woods are always moist; no wonder, therefore, that they contribute much to pools and streams. That trees are great promoters of lakes and rivers appears from a well-known fact in North America; for since the woods and forests have been grubbed and cleared, all bodies of water are much diminished: so that some streams, that were very considerable a century ago, will not now drive a common mill.—(Vide KALM’s *Travels in North America*.) Besides, most woodlands, forests, and chases, with us, abound with

pools and morasses; no doubt for the reason given above."—(Vol. I. 346 and 348.)

If these be credible facts, can we reconcile them with the hypothesis of radiation of heat. Can the phenomena be explained by that hypothesis? *Why* should trees and herbage condense such a volume of water? *Why* should a spot of freshly digged ground be *covered over with hoar frost*, when hard, unwrought ground, close to it, shall not exhibit one particle of rime, unless it be on spots where some weeds or projecting points may happen to be standing above the surface? These are, to the reflecting mind, subjects for deep interest and inquiry! However, if vegetable bodies become dewed, because they are the best radiators, and if they themselves be *vehicles of electric currents*; if, moreover, the flow and direction of their vital and secreted fluids be governed by the influence of those currents, then, connecting these facts, we must infer that the radiating power of plants, and their covering of dew depend upon the instrumentality of that agent which induces the flow of the ascending current of the sap, and the expulsion of the perspirable matter from the vessels of their leaves; and if so, the deposition of dew, whether derived from atmospheric moisture, or from that exuded by the plant, must of necessity be considered an electrical phenomenon.

199. *The deduction from all that has been stated is this,—we are to look for the solution of this wonderful phenomenon of dew to the agency of that principle, which induces not only the radiation of heat, the decomposition and evaporation of water, and its conversion into atmospheric air, but also those changes which are in perpetual operation in the aërial ocean.* In the sections on WATER, and on the ATMOSPHERE, I have entered somewhat at large upon the consideration of those surprising mutations, and therefore need not recapitulate in this place. The proximate or immediate causes of the precipitation of dew upon grass, and herbage, will, I think, be discovered in the peculiar structure and peculiar condition of vegetable bodies. This structure constitutes them, individually or collectively, not only perfect instruments of electric conduction, but also an assemblage of myriads of *points*, at which the *ascending and descending electrical currents meet and neutralize each other, depositing the aqueous particles which, till then, they had held in a state of repulsion, or of infinitely minute division.* It does not appear that grass and herbage are endued with the power of radiating or conducting heat, in a degree by any means equal to that of *metals*—substances which, it is said, do not become dewed at a time, and under circumstances, wherein the circumjacent herbage is covered with minute drops of water—a fact, which is not only very remarkable in itself, but one

that affords convincing proofs that plants do not become dewed solely by their power of radiating heat.

That herbage should not be dewed at all times, may be readily accounted for upon the principle of induction (see No. 68). If the surface of the earth, by its electrical condition, be rendered the *attracting surface*, when the state of the atmosphere is serene and tranquil, the floating vapours will be brought down, and deposited upon those vegetable points, where the electricities meet and neutralize each other. If, on the contrary, the air be the attracting medium, in consequence of the partial decomposition of its components, and the formation of aqueous electrified vapours, those vapours which are floating near the surface of the earth, the products of evaporation and vegetable transpiration, will be drawn upwards; and, instead of being deposited in the form of dew, will, in the aërial regions, be congregated into masses of clouds.

The solution of the phenomenon of the disappearance of dew already deposited, on the formation of a stratum of rain clouds will be found in a similar, but more sudden change or transference of the electric attractive surface. (See page 189, No. 193.)

200. *This view of the agency of induction* will discover the cause of the protection afforded to vegetables and fruit trees, by a covering placed above them. The stamens and pointals of blossoms are, in fact, so many pointed conductors of electricity, their office being to convey the fructifying juices, destined to mature the seed and fruits. In consequence of their form, they are equally subject to become dewed as grass is; if, then, the air be frosty, the particles of water, and the juices in their fine vessels, become frozen, and ice being a bad conductor of electricity, the vital currents are arrested, and the delicate organs of fructification materially injured or destroyed. But if an awning, weather boarding, or even a woollen net, be placed at some distance above the blossoms (see 86), the point of contact will be transferred from the vital organs of the seed to the two surfaces of the covering,—consequently, the regular flow of the ascending current, even to the extreme points of the vessels, being secured, the juices of the flower will be duly distributed, and the process of maturation proceed without impediment.

201. *Conclusion.*—Little now remains to be said: I have endeavoured to make it apparent, that the *radiation of heat* (being a mere effect) cannot afford a satisfactory solution of the phenomenon of the dew; and that, so far from being an active cause, radiation itself cannot be philosophically regarded otherwise than as a result of electro-magnetic decomposition, though, in the present infantile state of our knowledge, we are scarcely authorized to assert that we

have attained the entire solution of any mysterious natural phenomenon. The day, however, has dawned, the light has become manifest, and it may increase to an effulgence; still I do not hesitate to assert, that if ever we become qualified to determine with precision the operation of *causes*, it will be when philosophers, and men of scientific attainments, cease to cavil about terms—about the existence of *one or two* electricities, exerting a “plus or minus,” positive or negative energy—and shall not only perceive the intimate union that exists between the sciences of chemistry and electricity, but conduct all their experimental researches under the conviction, that electric agency, electric developements, and chemical affinities, are universally coincident with, and dependant upon, one another. Toward this consummation, the *Researches* of Dr. Faraday have marshalled the way.

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## SECTION II.

### PART I.

#### NATURAL HISTORY AND CULTIVATION OF ESCULENT VEGETABLES.

##### THE TUBEROUS-ROOTED TRIBE.

Subject 1. THE POTATOE:—*Solanum Tuberosum*. *Solanéeæ*.

Class v. Order i. *Pentandria Monogynia*, of Linnæus.

THE essential generic character of the genus *Solanum*, according to Smith, is a *berry* of two cells; *Corolla*, wheel-shaped; *Anthers*, with two pores.

202. *The Potatoe* is a perennial; it has a wheel-shaped corolla; five parted calyx, permanent; a germen becoming a fleshy fruit, containing many flat roundish seeds. The potatoe plant is valued almost entirely for its tuberous root, called potatoes; although the green berry, or apple, is not unfrequently preserved as a pickle. The stem of the plant rises from one to three feet high; it is herbaceous, succulent, and furnished with pinnated leaves; the flowers are whitish, or tinged with purple; the fruit, or apple, is a round berry, green at first, finally becoming of a blackish, dingy purple. The plant is supposed to be a native of South America. Humboldt is doubtful on the subject: but he admits that it is naturalized there in some situations.

“ Sir Joseph Banks ” (LOUDON 3646, from *Hort. Trans.* 1, 8) “ considers that the potatoe was first brought into Europe from the mountainous parts of South America, in the neighbourhood of Quito, where they were called *papas*, to Spain, in the early part of the sixteenth century. From Spain, where they were called *battatas*, they appear to have found their way first to Italy, where they received the same name, with the truffle, *taratoufli*. The potatoe was received by Clusius, at Vienna, in 1598, from the governor of Mons, in Hainault, who had procured it the year before, from one of the attendants of the pope’s legate, under the name of *taratoufli*, and learned from him that it was then in use in Italy. In Germany, it received the name of *cartoffel*, and spread rapidly even in Clusius’s time. To England, the potatoe found its way by a different route, being brought from Virginia by the colonists sent out by Sir Walter Raleigh, in 1584, and who returned in July, 1586, and probably,” according to Sir Joseph Banks, “ brought with them the potatoe.”

“ Gough, in his edition of CAMDEN’s *Britannia*, says that the potatoe was first planted by Sir Walter Raleigh, on his estate of Youghall, near Cork, and that it was ‘cherished and cultivated for food’ in that country, before its value was known in England; for although they were soon carried over from Ireland into Lancashire, Gerrard, who had this plant in his garden in 1597, under the name of *Battata Virginiana*, recommends the roots to be eaten as a delicate dish, and steeped in sack and sugar, or baked with marrow and spices, and even candied by the comfit-makers.”

“ The ‘kissing comfits’ of Falstaff,” and other confections, were, it is said, “ prepared of a *sweet* potatoe, or of eringo roots. Evelyn, in 1669, says, “ plant potatoes in your worst ground; take them up in November for winter spending; there will enough remain for a stock though ever so exactly gathered.”—(*Encyc. of Gard.*,—*Potatoes*.)

About the middle of the eighteenth century, they began to be known: since that period they have been extensively cultivated. In 1796, it appears that, in Essex alone, 1700 acres were planted with potatoes, for the London market. In Scotland, this root was but little understood till about the year 1740. It is stated in the *General Report of Scotland*, (Vol. ii. p. 111,) that, “ in the year 1725-6, the few potatoe plants then existing in gardens about Edinburgh, were left in the same spot of ground from year to year, as recommended by Evelyn; a few tubers were perhaps removed in autumn, and the parent plants were then well covered with litter,” by way of protection.—(*Idem*. See 3650.)

Dr. Paris observes (I believe in his *Pharmacologia*), that potatoes—

for nearly two centuries, were violently opposed, and particularly in France; till, at length, Louis XV. wore a bunch of the blossoms in the midst of his court; when, for the first time, the people obsequiously acknowledged the utility of the root. "After all this opposition," he observes, "potatoes are found to produce—*cottony flax*, from the stalk; *sugar*, from the root; *potass*, by combustion; *vinegar*, from the apples; *soap*, or a substitute in bleaching, from the tubercles; finally, when cooked by steam, the most farinaceous and economical of all vegetable food. So much for prejudice."

203. *Use of Potatoes*.—"The tubers of the potatoe, from having no peculiarity of taste, and consisting chiefly of starch, approach nearer to the nature of flour, or farina of grain, than any vegetable root production. With the flour of potatoes, puddings are made, nearly equal in flavour to those of millet: with a moderate proportion of wheat flour, bread of excellent quality may be formed of it; and potatoe starch, independently of its use in the laundry, is considered as equally delicate food as sago or arrow-root."—*Encyc. of Gard.*, 3651.)

204. Sir Humphry Davy, in speaking of the products of plants, thus notices the potatoe:—"In bulbous roots, and sometimes in common roots, a large quantity of starch, albumen, and mucilage, are often found deposited in the vessels; and they are most abundant after the sap has ceased to flow, and afford a nourishment for the early shoots made in spring. The *potatoe* is the bulb that contains the largest quantity of soluble matter in its cells and vessels; and it is of most importance in its application as food. *Potatoes in general afford from one-fifth to one-seventh, of their weight of dry starch*. From 100 parts of the common *kidney potatoe*, Dr. Pearson obtained from 23 to 20 of starch and mucilage; and 100 parts of the *apple potatoe* in various experiments, afforded me from 18 to 20 parts of pure starch."

From the analysis of Einhoff, it appears that 7680 parts of potatoe afford:—

Of Starch . . . . .	1153
Fibrous matter analogous to starch . . . . .	540
Albumen. . . . .	107
Mucilage in the state of a saturated solution. . . . .	312
	<hr/>
	2112

*Agric. Chem.* p. 128.

My own experiments accord sufficiently with the foregoing. In the year 1828, I paid considerable attention to the preparation of *potatoe starch*, with a view of ascertaining the exact quantity that

would be yielded by a given weight of the tubers; and after repeated experiments, I think I may affirm, that although some kinds yield more than others, yet the average quantity of starch in any given weight, will more frequently fall short of, than exceed, one-sixth part of the weight of the unpeeled roots. From some early potatoes, I obtained scarcely one pound from fourteen; the results of two experiments, which are now to be detailed, may be taken as an average of a great number of others.

The terms *flour* and *farina* should certainly be rejected: potatoes contain no flour in the proper acceptation of the term: that powdery substance which they deposit is *starch* or *amylum*, and it is wholly destitute of *gluten*—a substance indispensably required for the production of the mass of dough, which, after being duly fermented and baked, becomes bread. The *amylum* of potatoe will combine with wheaten, or other flour, in the proportion of one-eighth to one-fourth of the flour, and will tend to whiten the bread. It will do more, for if, as is sometimes the case, the fermentation be imperfect, the batch of bread, which if made of flour only, would be “*sad*” and doughy, will be improved in its texture, and instead of being brown and tough, will be whitish “*short*,” and, in proportion, more palatable and easy of digestion. But potatoe starch alone, can never be made into bread, and therefore cannot become a substitute for flour. However, it may be brought in as a very useful adjunct; for if a large stock of potatoes remain unconsumed at the end of a season, as was the case in 1828, when hundreds of sacks—the surplus of the vast yield of 1827—were thrown away, or given to pigs, being unsaleable at one shilling per sack; if, at such a time of plenty, some machines were employed to manufacture potatoe starch from the surplus stock, a valuable supply of very nutritious food would be prepared, which in the event of a bad harvest might tend to keep down the exorbitant price of bread flour.

#### *Results of two Experiments.*

##### (1.) From 8 pounds of unpeeled potatoes:—

Amylum, or starch . . . . .	1 lb. 6 oz.
Pulp, pressed by hand . . . . .	1 11
Loss in water or soluble matter. . . . .	4 15

##### (2.) From 8 pounds of peeled potatoes:—

Amylum, or starch . . . . .	1 3
Peelings, weighed . . . . .	1 5
Pulp, pressed . . . . .	1 14
Loss in water, &c . . . . .	3 10

*Thus it appears that the yield of starch is decreased by peeling, and*

therefore, the potatoes should be merely cleaned by brushing under water, and by repeated washings.

205. *Other Uses of the Potatoe: Salubrity.*—Potatoes appear to be particularly useful in the manufacture of bread, by promoting the fermentation of the dough. To effect this, they may be introduced among the flour, after being boiled to a mealy state; but the best method is to employ them as a ferment. For two pecks of flour, take from two to four pounds of mealy potatoes—the former quantity will be enough, if it be preferred. Boil them till they will pulp readily through a colander, and when lukewarm, add to the pulp *one-fourth* of the barm (*yeast*), which would have been used without potatoes. The pulp, if too dry, should be brought to the consistence of thin paste by the addition of milk-warm water, and then a table-spoonful or two of moist sugar or honey may be added: cover the mixture with a plate or cloth, and let it stand near the fire till a strong, frothy head arise. This potatoe yeast should be blended with about a twelfth or sixteenth part of the flour, to work as “sponge,” in the centre of the mass, in order to secure the fermentation of the whole. Some bakers, I have been credibly informed, have given two guineas for a receipt to prepare potatoe yeast; and it is considered so effectual in promoting fermentation, that the misfortune of a “*sad*” (heavy) batch is seldom incurred when it is used. It is said by some who ought to know the fact, that bread, worked with a due proportion of potatoes, is at least, two shades whiter in colour, and of much better texture than when it is wrought with the yeast of beer only: to which it may be added, that the bitter taste frequently communicated by such yeast, is wholly obviated, and the ferment can be employed liberally, with almost a certainty of a corresponding good result.

The question of the *salubrity* of the potatoe has been agitated with great partiality. By some, the root is said to possess poisonous qualities, particularly after hot and dry summers; and when used as the chief article of food, to be a proximate cause of typhus fever. By others, it is extolled as the finest, the most nutritive of vegetables. The truth is that millions employ the potatoe liberally, and remain strong and healthy: but with some it proves flatulent, and difficult of digestion. In an economical point of view, it can never be recommended as a substitute for bread; and they reason unwisely who compare potatoes with wheat, or other farinaceous substances. The analyses of Davy have proved, that out of four specimens of wheat, that which contained the smallest proportion of nutritive matter yielded—of *starch*, 70 parts, and of *gluten*, 24 parts = 94 parts out of 100. If a substitute for wheat must be found, let us seek it in

*Indian corn*, or other farinaceous grain, not in a tuberous, watery root, which, at the most, does not contain one-third of its weight of nutritive substance.

206. *Varieties of the Potatoe*.—These are very numerous, and they are generally distinguished by local names, known only in the immediate neighbourhood where they are produced. Loudon, from among the round sorts, selects the following:—

“The *champion*; early and late varieties.

The *ox-noble*; very large, and of peculiar flavour.

The *round red*; middle-sized, and smooth.

The *rough red*; or Lancashire.”

From the oblong:—

“The *red-nosed oval*.

The *oblong red*; varied with white.

The *oblong white*.

The *American red*.

The *Irish red*, or *pink*.

The *bright*, or *blood-red*, or *apple*.”

From among the kidney-shaped:—

“The common *white kidney*.

The *red kidney*; esteemed more hardy.

*Bangor Cup*; Irish, productive, and excellent.”

One of the best round varieties, is the early *Shaw*; it is of a medium size; the skin of a light clear brown, covered with a russety membrane, which gives it a degree of roughness to the touch; the tubers ripen early in the autumn, and keep well till March; the texture is mealy, and the flavour very pure. Among the early kidney, the ash-leaved is a peculiar and deserved favourite, and for winter stock, an oblong kidney, with pinkish eyes, and very white, mealy pulp, first introduced from Wales, by the late Mr. Grenfil; it is no doubt of Irish origin.

Dr. Hunter and Mr. Knight agree in opinion, that the duration of a variety is about fourteen years\*. Scotch and Irish potatoes are said to degenerate, when removed into England. Some varieties, such as the *early ash-leaved*, *early frame*, *early dwarf*, *early champion*, and *early Manchester*, do not produce blossoms; and, in the familiar language of some districts, are termed “no-blowers.”

207. *Propagation*.—The potatoe may be propagated from seed, by cuttings, by layers of the young shoots, by sprouts from the eyes,

\* If this opinion be correct,—and there appears sufficient reason to suppose that it is so,—it should be the endeavour of every practical horticulturist, to introduce new varieties, from seed suitable to local circumstances and peculiarities of soil, by crossing several approved qualities.

and by cuttings or portions of the potatoe, containing one, two, or three buds or eyes; and this method appears to be the best, is by far the most frequently practised, and is known to almost every cottager who possesses a rod of land.

(a.) By *seed*, to procure fresh varieties. The apples, according to Abercrombie, are to be gathered when fully ripe, in September and October, and the seeds taken out, and kept till spring. They are then to be sown (not thickly) in small drills; and when the young plants are two or three inches high, they are to be thinned to the distance of five or six inches. At the end of October, the roots will supply small potatoes, which must be taken up; of these, a portion of the best are to be preserved for planting, in the next spring. The succeeding summer's and autumn's growth, will determine the quality, and the approved varieties may be retained for future culture.

It may be asked, how is it possible to procure *seedlings* from varieties,—such as the famous *ash-leaved kidneys*, or other early potatoes, which produce little or no bloom? The practical answer has been returned by Mr. Knight. He plants a tuber which he wishes to render prolific, in a hillock of earth, raised from twelve to eighteen inches above the common level of the bed or border; and as the stalks advance in height, fastens them with shreds and nails, or by ties, to one or more strong stakes. He then pours from the spout of a watering pot, a heavy stream of water on the hillock, so as to wash away the soil from the tuber, and entirely to expose those processes of the roots which would bear the young potatoes, leaving the plant to communicate with the soil solely by means of the finer fibrous roots. By thus preventing the formation of a single individual potatoe, the vital energy of the leaves, which would otherwise have been exerted in the formation of tubers, is diverted to the *organs of fructification*; and thus, a crop of blossoms and seed is secured. These blossoms may be “crossed,” by obliterating the *stamens* of two or more varieties, and impregnating the remaining *pistillums* by the farina of some other. *One especial precaution*, must be minutely attended to; it is this:—The formation of underground tubers being prevented, *cauline bulbs*, that is, a kind of greenish bulbs, seated at the axils of the leaves, will often be produced. Every one of these must be immediately removed, otherwise the nutritive juices will be diverted from the organs of fructification, and the blossom will generally drop off, or prove abortive. When *fertile flowers* and *berries* are once produced, the seeds may be collected, and sowed according to the foregoing directions, or on a gentle hot-bed.

(b.) *By cuttings, or layers of the stalks, or by suckers.*—Cuttings of the young stalks, five or six inches in length, are to be set in the months of May and June, in fine light earth, or under a hand-glass. *Layers* of the stalks, more than a foot long, may be made, either with or without cutting: cover the layers with earth, three inches deep, and leave the extremities of the shoots exposed: they will emit roots at each joint, and produce full-grown potatoes in autumn. *Suckers*, or offset sucker roots, may be removed in June, and will produce a crop the same year.

(c.) *By portions of the roots, or tubers.*—This is the method by which the general crops are obtained; and the size of the cutting becomes an object of some consideration. Some extensive field planters,—and in districts where the finest potatoes are produced,—and whence, occasionally, many sacks are sent to London, although the distance is 100 miles,—select fine and *large* potatoes, and cut them into sets, containing each but one eye. Such sets, I am assured produce the best, and the most. The soil in which these fine potatoes grow, is chiefly sandy; much of it appears to be sharp, siliceous sand; but there is also an admixture of calcareous sand, and abundance of vegetable mould: it is grayish-black, perfectly light, and has not a gravel stone in it.

“Knight has found that for a late crop, small sets may be used because the plants of the late varieties always acquire a considerable age before they begin to generate tubers; but for an early crop, he recommends the largest tubers, having found that those uniform afford strong plants, and readily recover if injured by frost; because as they are fed by a copious reservoir beneath the soil, they speedily are re-supplied by vigorous stems and foliage, when those first produced are destroyed by frost or other cause.” He adds, “when a planter is anxious to have a crop within the least possible time, will find the position in which the tubers are placed to vegetate no means a point of indifference; for these being shoots or branches which have grown thick instead of elongating, retain the disposition of branches to propel their sap to their leading buds, or points distant from the stems of the plants, of which they once form parts. If the tubers be placed with their leading buds upwards, a few very strong and very early shoots will spring from them; if their position be reversed, many weaker and later shoots will be produced; and not only the earliness, but the quality of the produce, in size, will be much affected.”—(*Encyc. of Gard.*, No.

208. *Season and methods of planting.*—The first fortnight of April is a very proper season for planting the chief crops. *Early potatoes* may even be set in February or March; but the

be in more danger of receiving injury from frosts. The later sorts may be planted during the last fortnight of April, and thence to the end of May, and, occasionally, early in June. *The best soil* is a light, fresh, unmixed loam, so rich as to require no manure; or, if any, only that of vegetable compost from decayed leaves, turf, or the like. A soil inclining to *sandy*, is better than strong, heavy land; and the field is usually to be preferred to the garden. "Potatoes," M'Phael observes, "do not in general, prosper in a binding soil, unless plenty of opening manure be put into it. Where the soil is of this nature, he directs trenches to be made, about thirty inches, or three feet apart, and a layer of long dry dung, to be put into each; the potatoe cuttings to be set in the dung, in a row, about twelve inches apart, and then to be covered with earth, four or five inches deep. If the soil be light, some recommend the planting to be performed with a blunt pointed dibber, and if the plot be large, to use a strong dibber, about a yard long, with a cross handle at top, for both hands, the lower extremity to be shod with iron, and to have a short cross-piece, or shoulder, about four or five inches from the bottom, as a guide, to make the holes of equal depth, one person striking the holes, and a boy dropping a set into each hole. The earth is then to be struck upon them, as each row is planted, either with the dibber or hoe. Potatoes may be planted year after year in the same ground; I know those who say, that *for thirty years, potatoes have been set in the same spot*, and that with the assistance of no other manure than that of inland coal ashes and road sand.

209. Since the appearance of the first edition, I, among others, have profited by the experience of the late Mr. Knight, made known by his many luminous papers on potatoe-culture. My private correspondence on the subject, commenced in 1831: and from a letter, dated Feb. 4th of that year, I extract the following passage, which may serve as a compendium of Mr. Knight's principles and practice.

"I always plant the tubers *whole*, selecting the largest I can raise, and *from very early crops*," (these remarks allude to the *ash-leaved kidney*.) As respects winter store it is observed, "As a general rule, I think potatoes ought to be planted in rows distant from each other, in proportion to the height of the stems: the height of the stems being full three feet, the rows ought to be four feet apart, and the tubers of the *very largest varieties* planted *whole*, never to be more distant from centre to centre, than six inches. By such mode of planting, the greatest quantity of leaf, (the organ in which alone the vital, nutritive fluid is made,) is exposed to the light: the rows always pointing from north to south."

Always keeping these principles in view, yet having learned

from experience, and by perusal of the comparative experiments in the gardens of the Horticultural Society, that *sets*, properly selected and prepared, yield a greater return than entire potatoes, weight for weight, I have modified my practice; and find abundant reason to be satisfied with the results.

Entire tubers ensure success; but there, the advantage ceases, for many persons cannot spare a large stock for seed, and therefore, *sets*,—with never less than two or three, well defined eyes, taken from large potatoes; or the halves of tubers which do not exceed four ounces,—ought to be substituted, cutting them straight down from the crown, to the lower or root end.

I copy the following from an article I sent to the *Quarterly Journal of Agriculture*, which appeared in December, 1838. “In 1835, I adopted the practice of planting sets with the exception of those varieties—early or medium—which are naturally furnished with few eyes, situated near the crown. I found the yield to be quite equal to that obtained from entire tubers; so that the weight saved, was strictly economy of seed-stock. From the annexed statement of the plantings and proceeds of 1837, some opinion, however, may be formed on the subject, and if ash-leaved kidneys can be thus economized, a considerable saving of expense will be effected, as the dealers sometimes demand ten or twelve shillings per bushel, (often not weighing above 52 lb.) for seed potatoes.

Experiments of 1837; the varieties were:—

1. A long, *medium-early potatoe*, a variety of kidney—which assumes curious twists and curvings. The tubers become very long occasionally, but appear to be always of superior quality. This potatoe is good at any season from the time of digging, in September, to June following. There were planted in trenches, 26lbs. of *whole* potatoes: 12lbs. in the garden, between March 30 and April 5, and 14lbs. in an orchard plot, April 6, to 8. The total yield from the 26 lbs., was 354 lbs.

2. In the orchard at different dates between April 8, and 24.—*Early Shaws*, chiefly sets from 4-oz. tubers, with two and three eyes, limed; a few 2-oz. whole tubers were used separately; total, 30lbs. The crop was dugged Nov. 6—520 lbs.

3. *Downton Yam*. (Knight's.)—The seed-tubers, from three or four years' succession, in my own garden, cut into two and three-eyed sets, 22 lbs. 12 oz. The crop dugged at the same period—215 lbs.

4. *Early Champions*.—Their first crop, being an exchange with a person whose soil is extremely different from mine. Sets cut by divisions of the tubers from the crown to the root end, picking out

the central eye; and after liming, laying the cut sides downward, so that the broad surface of the eyes lay uppermost. Sown April 20, 13 lbs. Yield in November, 150 lbs.

In 1838, I obtained from 20 lbs. of Shaws (No. 2) 292 lbs. of extremely large potatoes: and from 25½ lbs. of the potatoe, the last in the list, (205,) called *Grenfell's Kidney*, cut in two and three-eyed sets, 478 lbs.

The soil with me is a hazel loam, binding in quality, in consequence of one of its chief constituents being a harsh, gravelly sand. By treating this earth with coal-ashes, (the best of all meliorators with clodding loams,) and by manuring with light, leafy compost, and decayed turf, it is in two or three years, reducible to ash fineness. It is my custom to alternate every season with one or other of the brassica family; and I find it excellent practice to set the potatoes in rows, five or six feet asunder, with a row of small savoys between each.

But the finest yield I ever obtained, was from a single tuber, weighing barely 3½ oz.; it was planted by way of experiment, in a heap of black heath or moor soil; and as the shoots advanced, each was pegged down and covered with the soil; the haulm produced, was in bulk and length prodigious; it lived and grew till the first severe frost of October last, when the leaves dropped off. In November, I found a complete mass of potatoes, 26 in number, some half a pound, others from 6 to 3 oz.: the total product 7½ lbs. beautifully fine. Not *one tuber* was found near the layered stems! Thus I detected one fallacy; but another point of great interest was established. The soil yielded to analysis, 52 grains of pure white sand, from only 60 grains; the 8 grains consisted of black vegetable matter, destructible by fire, with perhaps about one-fourth of a grain of iron and carbonate of lime (chalk): that is a mere trace of each; and yet, the haulm of the potatoe when burnt, yielded a considerable quantity of chalk! whence was this earth derived? was it from the soil which contains all but none, or from the atmosphere?

This experiment goes far to prove, that common manure is worse than useless; though reduced leaves may, to a certain extent, be excellent.

210. *My manipulation in planting* is twofold; one method applies to the earliest summer potatoes; the second to those for winter stock.

1. *Early varieties*.—Trenches, six or eight inches deep, and nearly a foot wide, are dug in February, or early in March; and the earth out of each, is thrown ridgeways on the sides. Into the soil at the bottom of the trenches, three or four inches of leafy,

duced manure are dugged; and then, if required, light earth is raked in, sufficient to raise the soil to within four or five inches of the original surface level. The ash-leaved, Scotch, or other earliest sorts are placed about four inches asunder, along the middle of the trench, the row or crown ends uppermost, and each is pressed into the soil. Earth is raked down to cover the tubers, to the depth of an inch; and occasionally, half an inch of sifted coal ashes, or decayed leaves is superadded; thus making the first covering an inch and a half deep. As soon as the first shoots appear, fine earth is raked or hoed from the ridges, till they are covered; and this process is repeated as the plants rise, till at length the trenches being filled, the level of the surface is restored, and a sufficient depth of earth is afforded to the tubers, and their radical processes. All that remains to be done, is to dig or fork the ground three inches deep, to give openness of texture.

The results of this mode of protection and culture can be described in a few words, being those witnessed in the spring and summer of the present year, 1838. I have seen whole ranks of potatoes (planted in the usual manner) blackened by the frost of one or two hours, and was informed that great destruction was produced by the frost of May 16. My thermometers indicated 6° (Fahr. 26°), but the potatoes were safe; no shoots were lost, the plants progressed to perfection, and from 12 or 13 lbs. of seed, in five trenches, I raised 169 lbs., of superior quality.

2. *Winter Stock*.—The ground is rendered light, and rich enough by ridging, ashing, and manuring, as before described, prior to the winter's frost. If, (as mine was,) it has been under early spring broccoli, it is to be dugged, the line stretched, and a drill trench chopped down with the spade, drawing the loosened soil forward till six inches deep. The sets are herein deposited, five or six inches apart; they are fresh-cut, and each raw surface is dipped in air-slaked lime, to absorb the juices, and repel insects. Earth, made as fine as possible with the spade, is thrown over the sets, made level, but pressed hard upon them; and each row is marked, as it is finished with an inch-deep covering of leafy manure, a foot wide.

Another space is dugged, and a second drill five or six feet distant from the first is formed, the sets are covered with earth, and the proposed stratum of light manure.

A marked tally, noting the variety, weight of tubers cutting, and the nature of the sets is put up at one end of the trench, and the like particulars are registered in a diary; thus the results are brought out nearly with arithmetical accuracy. These precautions are required in experimental horticulture, and they who can

them in the large way, will be no losers, either in theory or practice.

211. *The subsequent culture* consists in forking in the manure, as the plants attain six or seven inches of growth; then, after a week, if the weather be fine, and the ground free, in drawing an inch or two of the earth against the stems, on each side; finally, in destroying weeds, lightly digging the spaces, and in due time, (if required,) manuring a narrow trench exactly in the middle of each space, and planting the young savoys of the smallest *green* variety. This trench is not to be left open, but a small groove is made, as in planting young cabbages, just to shelter the stems, and admit of local watering. If the potatoes are very tall growers, Savoys cannot be admitted; therefore wide spaces are in every way advantageous.

212. *Taking the Crops.*—The early potatoes come in about the first or second week in July,—that is, as a general crop: they will continue to yield, and improve in quality, during August and September. The earliest potatoes should be dugged, in small quantities, as wanted for the table; because they will not keep, and should be boiled the same day that they are dugged.

As the roots advance to maturity, a larger quantity can be dugged up; and when the haulm is quite dry, and the potatoes ripe, the whole may be taken up. Let the main late crops continue in the ground undisturbed, till the haulm decay, which will be at the end of October, or early in November; then dig up the roots with a proper potatoe fork, with three or four flat tynes or prongs. Some advise to cut down the haulm, and to clear off, forward; then to fork up the potatoes, large and small, and to collect every forking into baskets. Care should be taken to clear the ground well, for potatoes will, otherwise, remain in it, for years; in fact, after three diggings and turnings, some will still remain. It is a good plan to trench the ground crossways, that is, at right angles with the direction in which the potatoes were dugged; and if the land can be spared, to raise it into ridges in order to obtain the benefit of the winter's frost.

213. *To preserve the Crops.*—M'Phael says, that, "if the ground be dry, you may let the potatoes remain; and cover them with long litter, to protect them from frost, and take them up as wanted." Others recommend pitting, or *pying*, as it is termed. Dig a space of ground in a very dry spot, (under cover of a shed would be desirable,) a full spit deep; lay the earth round the edges, and beat it firm and hard; make the bottom of the space quite level, and fill it with dry straw; place a coating of straw also within the border of earth; put in the potatoes, heaping them ridgeways. When all are in, cover

them with dry straw, to the thickness of at least six inches, and on that, lay earth or turf, to an equal depth. Beat it firm and compact with a wetted spade, and finish it off, so as to resemble a sloping roof, with the ends rounded or arched, that it may throw off the wet in every direction. When the frost is gone, open one end of the pit, take out what may be wanted, and either close it again, or look over the stock, and break off the advancing shoots, to prevent the exhaustion of the roots. This method of pitting is much practised, particularly when the quantity is large; but if there be but a few sacks, they may be effectually preserved by carefully drying the potatoes in the first instance, and then by keeping them in chests or boxes in a dry dark cellar. If they be preserved from frost and damp, it will only be needful to remove injured or decaying roots; this is a general principle; therefore, an underground cave, or excavation in a bank, or rock, where frost is excluded, while it admits the utmost degree short of actual freezing, offers the most certain means of protection. Dry cold is the preservative; all fermenting, decomposable, or moist coverings, do harm; they promote growth, and rob the potatoe. Darkness is another negative protector. Acting upon these principles, with no other materials than a cavity in the earth of thatched outbuildings, covered with boards and mats, I have preserved potatoes under 20 degrees of frost.

Subject 2. THE JERUSALEM ARTICHOKE:—*Helianthus Tuberosus*.  
Class xix. Order iii. *Syngenesia, Polygamia Frustanea*, of Linnæus.

214. *The Jerusalem Artichoke* is a native of Brazil, and appears to have been introduced in 1617. LONDON (No. 3688) says, “The epithet Jerusalem is a mere corruption of the Italian word *girasole* (from *girare*, to turn, and *sol*, the sun), or sun-flower; the name artichoke is bestowed from the resemblance in flavour which the tubers have to the bottoms of artichokes.” It is a species of the genus *Helianthus*, or sun-flower, but seldom produces flowers in this country. The roots are tubers, roundish, or oval, irregular, abounding with protuberances and fibres; “they are esteemed nutritious,” and, in fact, will produce a complete jelly; are eaten boiled, mashed with butter, or baked in pies, and have an excellent flavour.

215. *Propagation*.—Half a peck of roots, according to Abercrombie, will plant a row of 120 feet, if the sets be placed two feet distant in the row. The Jerusalem artichoke will grow anywhere; and from the rapidity with which it multiplies, and the pertinacity with which it adheres to the spot where once it is introduced, may become a troublesome weed: but still, to procure the roots in perfe-

tion, the soil should be in good condition. Select a spot by itself, dig it deeply, and manure it liberally. If the roots be large, cut them into sets, containing one, two, or three eyes; and in the latter end of February, or during March, plant the sets in shallow trenches four inches deep, two feet apart, and the sets eighteen inches asunder in the rows. A small bed, 20 feet long, by 6 feet wide, will produce a considerable supply. In almost every particular, observe the directions given for planting the potatoe (208); keep the ground free from weeds; and in November, when the stalks become completely dry, cut them off, and dig up the roots. Clear the bed entirely, if possible, letting none of the tubers remain; manure and plant it afresh the following spring, and thus the evil will be prevented which attends the spreading of the roots, when they are left to grow in a disorderly manner. The tubers may be preserved in dry sand all the winter.

To cook the tuber to perfection, the larger only should be selected, and *peeled* prior to boiling. The form and colour is then equal to those of fine white turnips, and the flavour is pure, and much more agreeable than when the roots are boiled without removing the peel.

## PART II.

### OPERATIONS IN THE VEGETABLE GARDEN, FOR THE MONTH OF MAY.

216. *Sow*—Indian corn, the dwarf variety (258), as early in the month as possible; kidney-beans, the dwarfs (31, 32), for a full crop, about the first week, and again towards the end of the month.

Scarlet and white runners, either in drills or seed beds (32); in the second week.

Peas and beans (24), for succession crops, as the earlier sowings appear above ground.

Carrots (76), for drawing young; once or twice.

Broccoli, purple cape (123), for autumnal supply; in the third or fourth week.

Portsmouth, white and purple (124), for the following spring; in the first week.

Borecole (118), Brussels sprouts (117), and any of the brassica tribe (108 to 110), for succession crops; during the month.

Turnip, the Dutch and Swedish; once or twice (332—334).

Cucumbers, either for picklers or for late supply: about the second week.

Vegetable marrow—set out the plants over manured beds.

Onions, for drawing while young, or for bulbs, to plant in the spring; in the third week.

Lettuce, the cos, or capuchin, for salad; at any time.

Scorzonera, salsafy, skirret; in the first or second week.

Plant potatoes (206), the winter main crops; throughout the month.

Transplant cabbages from the seed beds (110); cauliflower (121).

Celery into nursery rows; or some of the strongest plants into the final trenches, for early autumnal use; in the fourth week.

Attend to all the operations consistent with regularity, order, and neatness, according to the directions of the preceding months.

### SECTION III.

#### PART I.

#### NATURAL HISTORY AND CULTIVATION OF THE PLUM-TREE.

217. THE PLUM,—*Prunus Domestica*. *Rosaceæ*. Class xii. Order i.  
*Icosandria Monogynia*, of Linnæus,—

is a naturalized, if not a native tree. The genus *Prunus* includes the plum-tree, cherry, laurel, and several other cultivated trees, which are not indigenous, besides the following, which, being enumerated, and described by Sir J. E. Smith, in the *English Flora*, may be reckoned natives of the British Isles:—*Prunus Padus*, the bird cherry; *P. Cerasus*, the wild cherry; *P. Domestica*, the wild plum-tree; *P. Insititia*, the wild bullace; and *P. Spinosa*, the sloe, or black thorn. The *Prunus Domestica* is considered by some as the origin of all the cultivated plums; it is found wild in our hedges; but its original country is supposed to be Asia; and, according to Pliny, “it was brought from Syria into Greece, and thence into Italy.”

The cultivated plum-tree comprises a great number of varieties: these according to Loudon, amount to nearly one hundred. Tusser enumerates ten; Parkinson, sixty; Miller, only thirty-seven; the catalogue in the *Encyclopædia of Gardening* contains forty. In the *Library of Entertaining Knowledge*, we read—“There are nearly three hundred varieties of plums, many of which are, perhaps, only dissimilar in name. The Washington, a modern variety, which is stated in the *Pomological Magazine* not to be surpassed in richness of flavour, beauty, and other good qualities, by any, is curious in its

origin. The parent tree was purchased in the market of New York, some time in the end of the last century. It remained barren several years, till, during a violent thunder storm, the whole tree was struck to the earth and destroyed. The root afterwards threw out a number of vigorous shoots, all of which were allowed to remain, and finally produced fruit. It is, therefore, to be presumed, that the stock of the barren kind was the parent of this. Trees were sent to Mr. Robert Barclay, of Bury Hill, in 1819; and, in 1821, several others were sent to the Horticultural Society, by Dr. Hosach."—(*Fruits*, 316.)

218. *Selection of varieties* recommended by Forsyth for a small garden :—

Jaune hâtive,	Royal,	St. Catherine,	Wine-sour, for
Early damask,	Green-gage,	Imperatrice,	preserve.
Orleans,	Drap d'or,	Magnum bonum,	

To these add,—the *Downton Imperatrice*, a cross between magnum bonum and the old imperatrice, by F. A. Knight, Esq. It was exhibited in 1823, (see LINDLEY'S *Guide*, p. 462,) and

*Coe's Golden Drop*, a fine plum, retaining the form of the magnum bonum, but possessing much of the flavour of the green-gage. It was raised by the late Jervaise Coe, a market-gardener of Bury St. Edmonds, in Suffolk, more than thirty years ago, from the stone of a green-gage, the blossom of which he supposed, had been fertilized by the white magnum bonum, the two trees of which grew nearly in contact. Requires an east or west wall. (See *Idem*. No. 45, 462.)

219. *Propagation and Culture*.—Most of the varieties are propagated by grafting or budding on the *muscle*, or any other free-growing plum-stock, raised from the stone of the fruit, or from suckers; the former method is considered the best for permanent plantations. Grafting is said to be commonly practised in America. The common sorts, as the bullace and damson, are raised from suckers.

*Grafting* is performed in February and March; *budding*, in July and August, either very low in the stock, that is, within five or six inches from the ground, for dwarf wall-trees, or, at from four to six feet high, for half and full standards. When the first shoots from graft or bud, attain a year's growth, cut them down to a few eyes, to produce lateral shoots for training; and in two years the trees may be finally planted in the border where they are to remain.

Plum-trees produce their fruit on small natural spurs from the ends, and all along the sides of the bearing shoots. In pruning, therefore, the branches should not be shortened; but all fore-sigh

and back-shoots should be carefully removed, and the branches trained against the wall as regularly as possible. These trees may be trained as espaliers; in which case, the directions for pruning and training the espalier apple-tree (39) will apply to the plum-tree.

220. Forsyth and others decidedly prefer the horizontal method of training, and they direct, to "head down the leading upright shoot twice a year, till the wall be filled to the top." Forsyth says, "Never cut the stems of young plum-trees when first planted, but leave them till the buds begin to break; then, you may head them down to five or more eyes, always observing to leave an odd one for the leading shoot; remember to cut sloping towards the wall, and as near to an eye as possible; and thus managed, the shoots will soon fill the wall with fine wood. If you find that some of the shoots are too luxuriant, you may pinch them off with your finger and thumb, about the beginning of June, in the first year after planting; by doing which, you will obtain plenty of wood to fill the bottom of the wall. A great deal depends on the first and second years' management of your trees."

It is a question, now, whether a tree fresh planted, should be headed down, or curtailed in the first spring, or left till the spring of the second year. I have practised both methods with equal success; but upon the reflection that the equality of roots and branches ought to be maintained, it has appeared more rational to head down the maiden tree, and closely to *cut in* one already trained, just as the buds are inclined to break in the first March after planting; for then, if care has been taken to plant and fix the root with judgment, both roots and buds will start together, and the balance will, probably, be secured from the first.

221. *Pruning*.—The *summer pruning* is intended to regulate useless growths of the same spring, and may be commenced in May or June; and having taken off the misplaced shoots and fore-rights, retain a good supply of well placed branches, and train them carefully against the wall.

The *winter pruning* may be performed between November and March. Retrench superabundant wood, and cut out the worn out bearers, and all decayed wood, retaining well placed and healthy shoots. If vacancies occur, a strong young shoot may fill up the vacant place.—(ABERCROMBIE.)

M'Phael recommends, that "when these trees are trained, the spurs should never be suffered to extend far from the wall, for then *the fruit* in general will not derive much benefit from it, and the *tree* will be liable to harbour insects of various kinds."—"When

plum-trees are planted as *standards or dwarfs*, to grow and spread their branches nearly in a natural way; after they begin to bear fruit, they require no more pruning, than yearly to cut out the dead branches, and any superfluous ones which begin to crowd the bearing wood, or those which take the lead of others, and would disfigure the tree, and hinder the under branches from bearing."—(*Gard. Rem.* 134.)

222. *Soil and Aspect*.—Miller recommends a medium soil, neither too heavy and wet, nor too light and dry. Abercrombie prefers the soil of any fertile meadow or orchard; or if to be made, to take one half of fresh loam, one fourth of sharp sand, one sixth of road stuff, and one-twelfth of vegetable remains, decomposed dung, or animal matter. M'Phael says, that plums grow best in a brownish mellow, moderately light loam, rather sandy than clayey, of not less than three feet in depth. The aspect of the better sorts should be east, or south-east: other exposures may produce good plums of the less valuable kinds.

223. *Insects, Diseases, &c.*—The acarus, or red spider, is one of the most noxious enemies to the plum-tribe. Canker, and an exusion of the plum-tree gum are common diseases. For the insect, the solution of sulphuret of lime mentioned at No. 49, will probably prove the most effectual remedy. To cure the disease, it may be needful to head down the whole tree. In this case, according to Abercrombie, the soil being removed, and fresh added, as the young wood of plum-trees is apt to shoot very luxuriantly, it will be advisable to let the replacing soil be but moderately rich, so as to prevent in a degree this redundant luxuriance.

224. *Further Observations*.—The *plum* is one of the trees which generally appears to be the most neglected: it is ill trained, carelessly pruned, and very frequently permitted to assume a loose and straggling growth. Even the directions for its culture and training are more loose and indeterminate than the quality of the fruit appears to deserve. In the foregoing paragraphs, the reader will find those general directions which are given by writers of the old school: there is an exception, however, with respect to those contained in No. 219, which point out the advantage of the *horizontal* mode of training, a method that, if well understood, and steadily pursued, will not fail to produce handsome trees, and a large supply of fruit. At the time I arranged the foregoing directions, I had not seen a treatise on fruit-trees, which I subsequently have perused and studied with great and increasing interest. In it, the method of training the plum-tree horizontally, is laid down with much accuracy and judgment. The author is Mr. Charles Harrison, late

gardener to Lord Wharncliffe: his work has been so highly thought of, that "the London Horticultural Society have voted him their silver medal, as a mark of their approbation." I think it a duty to present the reader with a faint outline of Mr. Harrison's method of pruning and training this tree, and which will apply to others of the spur-bearing tribe. To do the subject complete justice, however, it would be needful to copy the whole twenty-second chapter; but that would be unjust to the author, whose *Treatise on the Management of Fruit-Trees* ought to be possessed and studied by every gardener whose aim it is to excel in the art of training.

225. *General View of the Plan.*—Each main branch is from the first, led off horizontally—that is, at a right angle from the central perpendicular stem; four branches are supposed to be produced annually, two on each side; and these are to be trained at the distance of one foot above those immediately below them. In the intervals between these main branches, subsidiary shoots arising from the buds or spurs, are from time to time trained in, four inches distant from the main branches, above and below, in alternate order, but so as not to crowd, or cross over one another. Thus, as the walls are presumed to be twelve feet high, and the trees to be planted twenty feet asunder, the allotted space will be furnished with the required number of main bearers, in six or seven years,

The distinguishing feature of the plan is formed by the peculiar management of the spurs. The spurs are of two kinds: those produced immediately from the main branches which are termed simply the *spurs*; others, which proceed from these original spurs, are designated *lateral* spurs. Neither the one nor the other are allowed to retain, upon an average, more than from four to six fruitful buds: therefore, when the buds become too numerous, the spurs are curtailed, and they are altogether cut out, and renewed when they become old and deformed.

Under such regulations, if the soil be good, and the aspect propitious, the tree, when fully formed, will present a regular and beautiful appearance: it will be well balanced, and duly supplied with growing shoots and fruitful buds,—the former, by their system of leaves, supplying the *principle of growth*; the latter tending to prevent that over luxuriance of growth, and consequent sterility, which are of common occurrence in trees, where a wise, and yet rigid method of pruning is neglected.

#### PARTICULAR DIRECTIONS.

226. *Choice of the Tree.*—A maiden plant—one year old from the budding, or grafting, is preferred; it is to be planted in the

autumn, in a strong, rather than sandy loam, because the fruit is not supposed to set so freely, nor to attain so large a size, when the tree is planted in light sandy soil. The future operations consist in a winter pruning, and summer regulation: the author has given minute directions for performing both the operations during the period of eleven years, when the tree may be presumed to have attained to a state of perfection. He thus commences his directions:—

227. *First Year—Winter pruning.*—"The tree must be headed down in the spring. If it be a strong one, cut it down to seven buds; but if a weakly one, to three buds. When the shoots have pushed about two or three inches long, the uppermost shoot must be trained up straight to the wall; and of the other shoots, the two uppermost and the two lowest must be trained, two on each side of the main stem, and the two remaining must be rubbed off. As the shoots advance, let them be carefully nailed to the wall. When the upright shoot has pushed about eighteen inches in length, let the top be pinched off, so as to leave it about thirteen inches. This pinching back the shoot ought not to be later than the end of June or beginning of July. From the upper part of the shoot thus shortened, three or four lateral ones will generally push during the present summer, three of them must be kept, the uppermost to be trained straight up to the wall, and one on each side. The branches must be trained at twelve inches apart, for if nearer than this, under my mode of training the Plum, a proper sufficiency of sun and air would not be admitted to the spurs, &c."

By adopting this simple and effectual mode of cutting down the current year's shoot in June, as Loudon remarks, "Harrison gains annually, a year, as side shoots are produced on the young wood of that year, as well as on the last year's wood, from which it proceeds." This first year, if the tree be a strong one, he, in fact, gains six branches,—four during the spring growth, and two others, from the young leader, after it has been shortened in June.

228. *Second Year—Winter pruning.*—"That part of the upright leading shoot which rises above the two uppermost branches of last summer's growth, is to be shortened to thirteen inches.

229. *Summer pruning.*—"The regular pruning with a view to induce the formation of spurs, now commences. In order to comprehend this important work, the reader should pay attention to the age and circumstances of the tree: it was at the time of planting in the autumn, about one year old from the working. That time, we will presume, was the autumn of 1828, and in the spring following, (that of 1829,) it was cut down to seven buds; during

the succeeding growing season it produced six main branches and a leader. This leader, in the autumn of 1829, was, as we have seen, shortened to thirteen inches; and now, in the spring of 1830, the tree is about *two* years and a half old, and has been planted *one year and six months*. At the period of the summer pruning or regulation of 1830, “the buds upon *that part of each branch which was produced last year*” will be formed either into fruitful ones, or push into shoots. Our author thus continues:—“If shoots, they will require to be cut down to two inches in length, when they have attained a little woodiness, which will generally be the case when they have pushed ten inches in length. If, after being pruned down as directed, they should push again several inches long, the cutting of them back to two inches may be repeated, and this as frequently as required. The shortening of such shoots will generally cause them to form a fruitful bud, or more near to their origin.”

230. Let us examine the philosophy of the facts thus plainly stated. By curtailing the shoots, the regular course of the ascending currents is interrupted, and its direction changed. The few leaves which remain upon the lower part of each shortened shoot now become the sole intermedia through which the maturing influences of light and air are exerted; the buds situated at their bases are excited and swell, and the electrical currents setting in, to and through the pointed terminations of those buds, and of their leafy appendages, stimulate the former, and bring them into a fruit-bearing condition. The interruption of the principle of growth, by whatever means effected, is always productive of fertility; hence, though we may not be able to trace the operation of causes in all its minutiae, we may, I think, safely ascribe the effect thus produced, to the energy of the great natural agents, exerted *laterally*, through a greatly diminished number of the vegetable vital organs. The check thus given by the curtailment of the shoots will, it is true, be only temporary; but its frequent repetition will, in the end, prove effectual, and the wood of the *first year's growth*, at the next pruning, will be in a state not very different from that shown in the figure (4).

231. *Third Year—Winter pruning.*—It should be carefully noted, that from this period the author limits his directions to the spurs upon that part of each branch made the first year after the tree was planted (1829). “*The same practice is applicable to all spurs upon any other part of the tree at a similar period and condition.*”

After the fall of the leaf in the autumn of this third year, there

will be three species of spurs upon the wood of 1829, which is marked 1st 1st in the figure (4). These are first, *a a*, *natural* spurs, bearing chiefly fruitful buds, distinguished by being open and roundish. Second, *b*, other spurs bearing fruitful buds, which may be styled *induced* spurs, as they have been caused by the shortening of the shoots in summer. Third, spurs producing only growing buds, *c*, or the embryos of a bud or shoot, *d*. The author's directions are the following:—

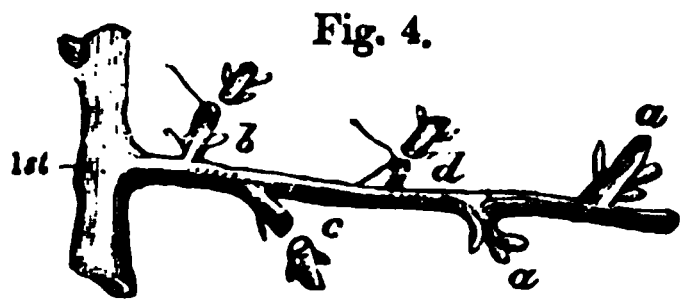


Fig. 4.

Those buds upon the first year's wood which pushed into shoots, and were shortened during the last summer, must now be pruned down, so as to leave two fruit buds, (see *b* \). If there be not a growing bud situated near to the bottom, there is always an eye, or embryo, of a future bud; and, in that case, the shoot must be cut off just above it, at *d* \. All the *natural* fruit buds, *a a*, will be productive the ensuing summer.

*Summer pruning—1831.*—The tree having been planted two years and about eight months, these directions are important, and will apply to the operations of the three succeeding summers. "All shoots which push upon those spurs that bear fruit, must be shortened down to three or four eyes, which will generally be to leave them about one inch and a half long: they must be thus cut down when they have pushed about eight inches. If they require shortening again, it must be done as before. All shoots which are produced in future upon any part of the tree, may, during the summer, be shortened agreeably to instructions given."

232. It will be obvious, that at this present period, the wood of 1830 will be nearly in the same state of maturity as that of 1829 was at a corresponding period of the last year; and, therefore, the regulation of the present summer will cause the developement of many more buds upon the earlier spurs, and some, also, upon the wood of 1830. That part of the author's directions which refers to the young shoots proceeding *from the spurs which bore fruit*, is important, because the first *lateral* spurs will be produced upon the spurs so shortened. These laterals become very apparent at the periods of the fifth or sixth winter pruning, as will be seen in the following figure. I pass over the directions for the fourth year, with the exception of one particular: it is this. If shoots cut down, as at *c*, fig. 4, had, during the following summer, produced other shoots instead of fruitful buds, they must be again cut down at the fourth winter pruning to the lowest bud or embryo there may be upon them, as at *d* \, fig. 4. If a shoot again proceed from each

one thus cut down, instead of a fruitful bud, it "must not be shortened at the summer's pruning to one inch and a half, as directed for all others; but at the time when the other shoots are pruned, which will be about the end of June, or early in July, it must be nailed to the wall, in a horizontal direction, and an inch or two only cut off at the end. The nailing of the shoot in this manner will cause it to produce a fruitful bud or two near to its origin. This practice may be successfully adopted with all shoots it is desired to render fructiferous in any part of the tree, particularly with those which through a vigorous habit, produce two or three shoots from the side of a spur, in which case, one or two of them must be trained in, and the others cut clean away. In selecting those to be trained in, always preserve such as are situated nearest to the origin of the spur that produces them."

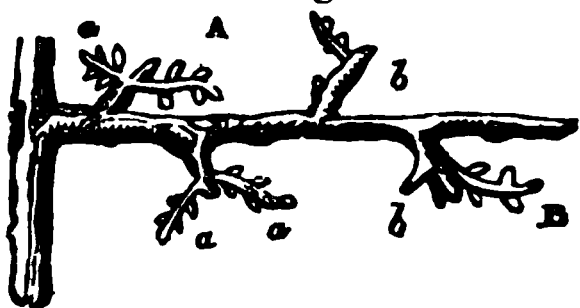
This *nailing in* is another means by which the currents of the shoot or branch may be interrupted, and fertility induced. By training those shoots horizontally, and close to the wall, which would have proceeded in very different directions, the vessels become bent or strained, and lateral attractions take place in lieu of those which would have been in a direct course.

233. *Fifth year—Winter pruning, 1832.*—All the fruitful buds must remain upon every spur: the *lateral* spurs induced by shortening at the summer's regulation, the shoots proceeding from the original spur, will now, in many instances, be furnished with four or five fruitful buds. If the shoots nailed in (see No. 232) during the preceding regulation, be still destitute of fruitful buds, they must remain at their entire length for another year.

234. *Sixth Year—Winter Pruning, 1833.*—By attention during the preceding summer to the directions already given, the spurs on the wood of the *first year, 1829*, will be in a state resembling that in the adjoining figure, where *A a* represent the lateral spurs, *B b* spurs whereon are both simple buds and lateral spurs.

The author's directions are:—"All spurs upon the first year's

Fig. 5.



wood must now be cut down, so as only to leave such a quantity of fruitful buds as represented.—(See *A, a, a, a.*) Such clusters of blooming buds upon so short a stem, I term lateral spurs. After they are thus pruned, let the *first* spur nearest to the origin of the branch, as spur *A*,

it be well situated, so that it can be brought to the wall without much force being used, (otherwise the nearest spur that is proper situated,) be nailed close to the wall, and at twelve inches further

the branch, and *on the opposite* side of it, let another be nailed in, as B. If that part of the branch made the first year after planting of the tree should extend twelve inches further still, another shoot must be nailed in at that distance from the second, but on the same side of the branch as the first. *This practice of nailing in spurs, must be pursued in every other part of the tree when they are at a similar age and condition.*

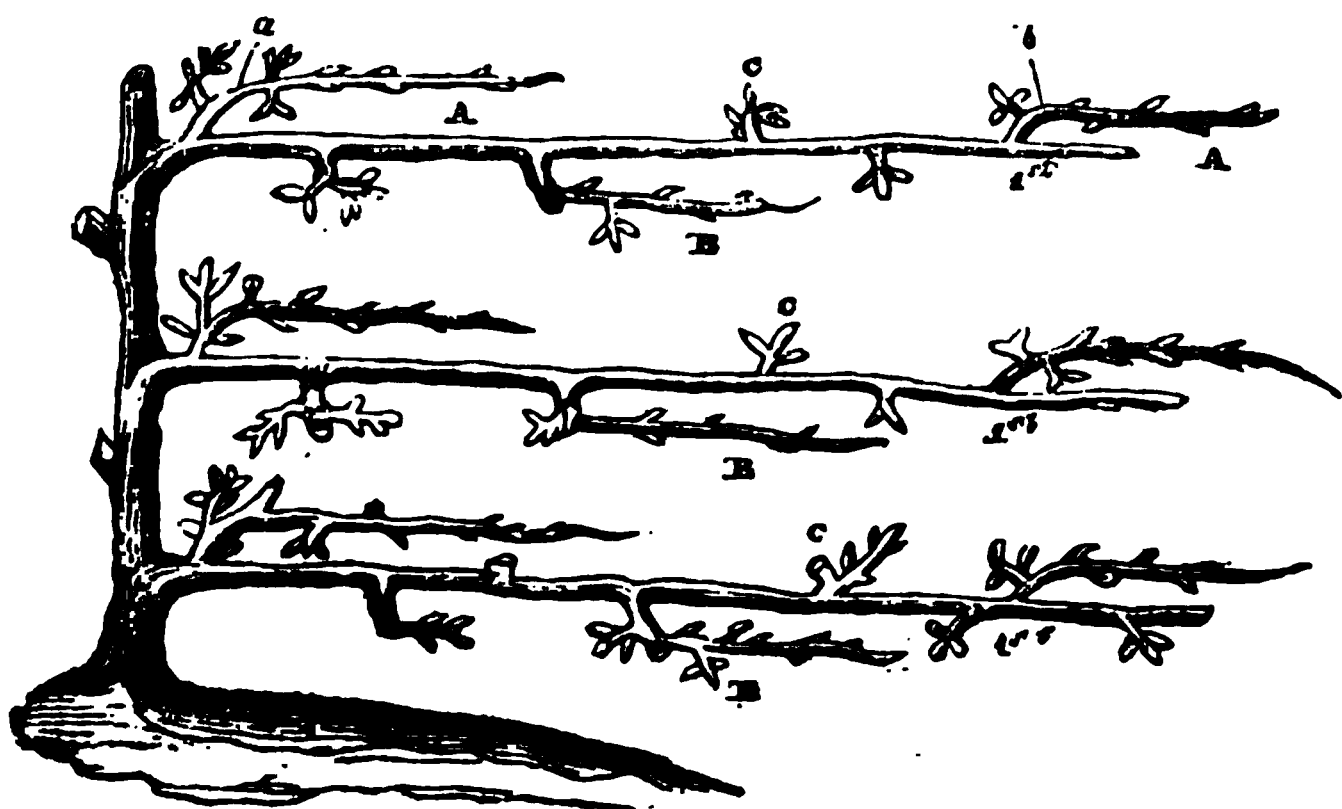
By training in those lateral spurs A, B, which naturally assume a horizontal direction, the author prepares for the production of the *subsidiary* shoots, which ultimately will furnish the spaces between the main branches, with bearing wood. At the succeeding regulation, or

*Sixth Year's Summer Pruning, 1834.*—The spurs nailed in, will produce shoots, which must be trained in at the distance of four inches from the branch from which they proceed. “If more than one shoot pushes from a shoot thus trained in, all above that number must be shortened at the end of June, or early in July, to about an inch and a-half, and this must be repeated, if required, as directed for the summer pruning of similar shoots. Also, all shoots which are produced upon those spurs which were cut down, but were not nailed to the wall, must be shortened as directed for the general summer pruning.”—See 229.

235. *Seventh Year—Winter Pruning.*—The shoots from the spurs trained in between the branches A B, fig. 5, are to be retained at their entire length. “The spurs which did not require training in must have all their fruitful buds retained, and the shoots which were produced and shortened last summer, must now be cut entirely out, or be cut partially down, agreeably to the previous directions.”

Having thus presented the reader with a review of so much of

Fig. 6.



the twenty-second chapter of Mr. HARRISON'S *Treatise* as applies to the plum-tree, till it attains its first stage of complete developement, it remains to attempt a description of the tree, by a drawing, which may convey some idea of its appearance when it becomes completely formed.

Figure 6 represents a portion of three of the branches, at the period of the seventh winter's pruning, when the wood of the *first year*—1st, 1st, 1st—is furnished with subsidiary shoots A, A, B, B, produced by the training in of the lateral spurs; c, c, c, are intermediate spurs, which will be cut out as the shoots advance. The main branches of the tree are twelve inches asunder; the shoots are four inches above and below the branches from which they proceed; consequently, every part of the allotted space becomes supplied with bearing wood at regular distances.

The course of improvement is so rapid, that no one can say what ultimately may be effected; but it appears almost impossible to imagine any object of the kind more beautiful than a tree so trained when arrived at its full growth, and all its branches fully furnished with subsidiary shoots. A tree, it is true, cannot be expected to grow precisely according to rule; shoots and spurs will protrude irregularly; still, however, so much depends upon the skill and attention of the gardener, that, although he cannot command exact uniformity, he may do much towards its attainment—at all events, he can effectually guard against confusion and disorder.

236.—*In the progressive growth of the tree*, attention will be required to prevent crowding. At the *eighth pruning*, the author observes:—"When the shoots trained in have extended so far as to interfere with the next shoots trained in on the same side of the branch, they must be cut off close to them, at which length they must be kept." At the *eleventh pruning*, he says:—"Every other of those shoots trained in from that part of the branch made the first year, must now be pruned back to the lowest bud there is upon them—a, b; but when a *second renewal* is required, I cut the shoot down to an eye, or embryo, of a bud" (just above the main branches); "and at the *third*, to a bud or spur. When the shoots, produced by cutting back those as a, b, have come to a bearing condition, the following winter pruning, the remaining shoots, B, B, B, must be also pruned to the lowest bud or spur."

The directions given for any one branch, and the references also, apply equally to all the branches of a corresponding age.

"My reasons," the author concludes, "for treating the plum-tree in the manner laid down, is, that when nothing but spurs are allowed upon the branches, the trees are not so fruitful, by reason of being

too luxuriant. But by allowing shoots to be trained in between the branches as directed, the sap is properly employed in the production of fruit."—See *General Remarks*, 225.

## PART II.

### OPERATIONS IN THE FRUIT DEPARTMENT.

237.—*Summer pruning* of the apple, peach, apricot, vine, and most other fruit trees, should now be commenced. If mildew appear, dust the branches with sulphur, or sprinkle them with an infusion of tobacco; if insects be found in the leaves, pick those off immediately.

Take off strawberry runners; water strawberry plants copiously, once or twice, if the weather be dry.

*Look over the grafts*, and if the scions appear securely knitted, remove the clay and bandages.

*Head down* old, unproductive plum, pear, cherry, or apple trees.

Destroy weeds, slugs, snails, and all other vermin. A little hot lime, sprinkled about the stems of plants, will destroy slugs: it may be mixed with one-sixth of soot.

### MISCELLANEOUS.

238.—*Sow* succession, annual, and biennial flower seeds; heart's-ease, candytuft, alysson, hawk-weed, convolvulus minor and major, mignonette, Indian pink, marvel of Peru, chrysanthemum, dianthus, of various sorts.

*Plant* stocks, sweet-william, wall-flower, pinks; also cuttings of double lychnis, rocket, and wall-flower; and the orchis tribe, of which there are four or five now in flower.

Gravel walks may be turned; grass edgings cut, grass-plots mown, and edges clipped: in all these operations remove leaves and litter of every kind to the compost heaps, to insure neatness, and to produce vegetable mould—a manure which forms the purest of vegetable aliments.

### *Select Shrubs and Plants that flower in the Month of May.*

239. *Trees and Shrubs*.—The apple, *Pyrus malus*, with its profusion of ornamental and fragrant clusters of crimson-tinted blossoms; Lilac, common and Persian, *Syringa vulgaris et persica*; Dwarf almond, *Amygdalus nana*; Rose, China and others, *Rosa Indica*, &c.; Pontic rose-bay, *Rhododendron ponticum*; Azalea,

yellow, white, and scarlet, *Azalia pontica*, *præcox et nudiflora cocc.* Rose acacia, *Robinia hispida*; *Deutzia*.

*Perennial Herbaceous Plants*.—Minor periwinkle, white, blue and purple, *Vinca minor*, *rars.*; Columbine, *Aquilegia vulgaris* Globe flower, *Trollius Asiaticus et Europæus*; Single Peony, *Pæoni officinalis*; Lily of the valley, *Convallaria majalis*; American cow slip, *Dodecatheon mœdia*; Double ranunculus, *R. flore-pleno*, &c.

*Bulbous Roots*.—Orchis, green-winged, early purple, brown, and military, *O. morio*, *mascula*, *fusca*, *et militaris*; Jonquil, *Narcissus jonquilla*; Tiger lily, *Lilium bulbiferum*; various sorts of *Narcissus* and Tulips, *Tulipa gesneriana*, &c.

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## THE NATURALISTS' CALENDAR.

## MAY.

**G**REAT part of May is yet too chill for a perfect enjoyment of the charms of nature, and frequent injury is sustained by the flowers and young fruit during its course, from blights and blasting winds.

The latter part of the month, however, on the whole, is, even in this country, sufficiently profuse in beauty. A cold and windy May is accounted favourable to the corn, which, if brought forward by early warm weather, is apt to run into stalk, while its ears remain thin and light.—(AIKIN'S *Calend. of the Year.*)

I register the morning of the 7th of May, 1831, as rendered remarkable by one of the most sudden, and extensively fatal frosts, that has occurred of late years. The preceding evening had been clear, and the air keen, but no actual frost was discernible till four o'clock of the morning; one hour or two then sufficed to destroy, and scorch, as if by fire, the potatoes, the young shoots of the ash, walnut, and mulberry; and, what was of far more importance, it cut off perhaps nine-tenths of the cherries, plums, pears, and apples throughout the greater part of England. The May of 1837 was peculiarly cold and severely frosty, till the last week. The same can be said of May, 1838; it was cold and arid, and the frost of the 16th injured the kidney-beans and young potatoes.

Average height of the Barometer is about 29 in. 95 cts.

Ditto of the Thermometer about 54 degrees.

*In the first week.*—The glow-worm (*Lampyrus noctiluca*) shines; fern-owl or goat-sucker, (*Caprimulgus europæus*) appears; swift (*Hirundo Apus*) arrives; cuckoo (*Cuculus canorus*) is heard.

*Second week.*—Fly-catcher (*Stoparola grisola*) appears; grasshopper lark (*Alauda trivialis*) heard; admiral, or admirable butterfly (*Papilio atalanta*) seen.

*Third week.*—Wood argus butterfly (*Papilio Aegeria*), Burnet hawk-moth (*Sphinx filipendulæ*), appear; bat (*Vespertilio murinus*) seen.

*Fourth week.*—Female brood-wasps (*Vespa vulgaris*) appear; bees (*Apis mellifica*) swarm; cabbage butterfly (*Papilio brassica*), dragon fly (*Libellula quadri-punctata*), appear.

## JUNE.



## SECTION I.

## SCIENCE OF GARDENING.

## VEGETABLE PHYSIOLOGY.



## PART I.

## OF THE EXTERNAL ORGANS OF PLANTS.

240. THE term Physiology (*Physiologia*) is derived from two Greek words, namely, φύσις, *phusis*, nature; and λέγω, *lego*, to describe, to trace, or to discourse of. Hence it implies a description, or tracing of nature; and *vegetable* physiology, therefore, is a description of the nature of vegetables: the term is used in common with another, namely, Phytology, which is derived from φυτόν, *phuton*, a plant; and λέγω, to describe, &c., and means a description, or discourse, of or concerning *plants*. The science of phytology, or vegetable physiology, may be defined as the knowledge of those organs, external and internal, which compose the vegetable organized being; and it admits of being divided into two principal parts: the first comprises all those members or integuments that are discoverable by external examination; the second part includes those vessels or internal organs, which can be detected and discerned only by the aid of vegetable anatomy, assisted by a powerful microscope.

241. *The external parts of plants* are frequently termed the decomposite, or decompound organs; because they are not *simple* in their structure, but composed of more than one part or member. The term, however, appears to be objectionable, as it leads to confusion and misconception. Thus Dr. Smith, in a note at page 180 of his *Introduction to Botany*, when referring to the term “decomposite” as applied to leaves, observes that Linnæus, in *Phil. Bot.* 47, gives an erroneous definition of this term, which does not accord with his own use of it. I have introduced the term in this place, merely with the view to explain it—to render its meaning familiar: *I shall disclaim the future use of it, after observing that the parts of plants which are styled their decomposite organs, include the root,*

stem, branches, and their appendages of leaves, down, bristles, prickles, &c.; and also the external organs of fructification—the calyx, corolla, stamina, germ, seed-vessel, and fruit; all of which are compound organs, being composed of a variety of parts, capable, to a certain extent, of being separated and divided. These decomposite or external organs will form the subject of the present section; but for the particular description of each, I find myself chiefly indebted to the works of the late Sir J.E. Smith, and from them I have quoted very freely.

Notwithstanding the great efforts made of late years to establish the natural system of botany, I find no reason to depart from the original arrangement of my three leading sections, of which this is the first. Yet I feel much pleasure in being able to refer the reader who wishes to enter into a more minute investigation, to the numbers on *Botany*, published by the *Society for the diffusion of Useful Knowledge*; to DR. LINDLEY'S *Ladies' Botany*; to the *Introduction to the Natural System*, by the same author; to the new works of Dr. Hooker; and to DECANDOLLE'S *Vegetable Organography*.

In this elementary treatise, I have attempted to convey to the uninitiated reader some knowledge of the derivation of words: for I have thought that the gardener should become acquainted with the meaning of those terms that “flow trippingly on his tongue;” but which, when not felt and understood, are, in fact, little better than so many barbarisms of speech. It has also been my desire to remove a certain prejudice from the minds of the more delicate and refined class of readers, which is apt to imagine that gardening is but a grovelling pursuit. I wish to prove that the Science of Gardening implies a liberal education, and that it cannot fail to elevate the character of every one who pursues it.

I have chiefly consulted the *Fundamental Words of the Greek Language*, and the *Latin Etymological Dictionary* of Valpy. Some of the terms appear to have a very remote origin, and to convey strained and indeterminate ideas, which might almost warrant the conjecture that they originated in poetical license. I may, however, have erred occasionally, in endeavouring to trace the etymology of a word, and therefore shall be thankful to receive intimation, through the medium of the publisher, on this or other important matter, which may enable me to correct any certain error previously to the appearance of future editions.

242. *Of the Root*;—Radix (from  $\rho\acute{\alpha}\delta\iota\varsigma$ , *radix*, a branch, or twig, descending, as well as ascending).—“Every plant examined as to external structure, displays at least four systems of organs, or some analogous parts:—first, the root; secondly, the trunk and

*branches*, or *stem*; thirdly, the *leaves*; and, fourthly, the *flowers* or *seeds*.

“The *root* is that part of the vegetable which least impresses the eye; but it is absolutely necessary. It attaches the plant to the surface, is its organ of nourishment, and the apparatus by which it imbibes food from the soil. The roots of the plants, in the anatomical division, are very similar to the trunk and branches. The root may, indeed, be said to be a continuation of the trunk, terminating in minute ramifications and filaments, and not in leaves.”—(*Agric. Chem.* 53.)

“The root consists of two parts—*Caudex*” (a stem or trunk), “the body of the root: and *Radicula*” (a little root, or rootlet), “the fibre. The latter only is essential, being the part which imbibes nourishment.”

“Roots are either of annual, biennial, or perennial duration. The first belongs to plants which live only one year, or rather one summer—as barley.” Second, biennial—as in the case of any plant “that is produced one year, and flowers another, provided it flowers but once; whether that event takes place the second year, as usual; or whether, from unfavourable circumstances, it may happen to be deferred to any future time. This is often the case with the *Lavatera arborea*—Tree Mallow.” Third, perennial—“those which live and blossom through many succeeding seasons, to an indefinite period—as trees, and many herbaceous plants.”

The generality of roots may be arranged under the following heads:—

(a.) *Radix fibrosa*.—A fibrous root; the most simple in its nature of all, consisting only of fibres, either branched or undivided, which convey nourishment directly to the basis of the stem or leaves; as *Poa annua*—Annual meadow grass.

(b.) *Radix repens*.—A creeping root; as in mint, *Mentha*; a kind of subterraneous stem, creeping and branching off horizontally, and throwing out fibres as it goes. This kind of root is extremely tenacious of life, for any portion of it will grow.

(c.) *Radix Fusiformis*.—A spindle-shaped or tapering root. Of this, the carrot, parsnep, and radish are familiar examples. The *caudex*, which is the spindle-shaped part, abounds with the proper secreted juices of the plant, and throws out numerous fibres or radicles, which are, in fact, the real roots, as they alone imbibe nourishment.

(d.) *Radix præmorsa*.—An abrupt root; is naturally inclined to the last-mentioned form, but, from some decay or interruption in its descending point, it becomes abrupt, or as if *bitten* off. Of this root,

*Scabiosa succisa*, Devil's-bit scabious, is an example. Gerarde says, "The great part of the root seemeth to be bitten away; old fantastick charmers report, that the divel did bite it for envie, because it is an herbe that hath so many good vertues, and is so beneficial to mankind." Dr. Smith adds,—“The malice of the devil has unhappily been so successful, that no virtues can now be found in the remainder of the root or herb.” But although this may, unhappily, be true, the plant possesses one virtue at least; for the *flower*, with its beautiful purple-blue tint, and compact elegant heads, forms one of the chief decorations of the grassy alleys of woods and copses during the month of August.

(e.) *Radix tuberosa*.—"A tuberous or knobbed root, is of many different kinds. The most genuine consists of fleshy knobs, various in form, connected by common stalks or fibres—as in potatoe, *Solanum tuberosum*; and Jerusalem artichoke, *Helianthus tuberosus*. These knobs are reservoirs of nourishment, moisture, and vital energy." In some plants they are annual; in the Orchis tribe they are mostly biennial, and vary considerably in form.

This species of *tuber* cannot, in strict truth, be considered a *root*; it is rather an enlarged stem. A *root proper*, according to Lindley, is distinguished from a *stem*, "by the absence of leaves in *any* state, of regular leaf-buds, of evaporating pores." But the potatoe, and many other bulb-like processes, contain buds or eyes which develop leaves and stems: they cannot therefore be considered *roots*.

(f.) *Radix bulbosa*.—"A bulbous root, properly so called, is either solid, as in crocus; *tunicate*, composed of concentric layers enveloping one another, as in *Allium*, the onion tribe; or scaly, consisting of fleshy scales, connected only at their base, as in *Lilium*, the white and orange lily."

These bulbous roots "are reservoirs of the vital powers of the plant during the season when those powers are torpid or latent; and, in order to perform the functions of roots, they first produce fibres, which are the actual roots."

(g.) *Radix articulata*, or *granulata*.—"A jointed or granulated root, agrees very much with those described at (f.) The *Oxalis acetosella*, wood-sorrel—and *Saxifraga granulata*, white saxifrage—are instances of it. The former has most affinity with scaly bulbs, the latter with solid ones."—(See SMITH'S *Introduction*, chap. xii.)

Nearly allied to the creeping root, is *Rhizoma*, the root stock; but the former is found, always, *under* the surface; whereas, the latter frequently is prostrate upon it. See a very minute description in the *Treatise of Botany*, of the *Society for the Diffusion of Useful Knowledge*, No. I., p. 11, where examples are given, with wood-cuts

of the Iris, the common polypodes, and *Lathræa Squamaria*. *Couch-grass* may be referred to as familiar to every one.

243. *The Stem or Trunk*—Caudex (from *καύω* or *κάω*—*kauō* or *kaō*—to scoop, hollow, to cut or fell)—is composed of three principal parts—the bark with its external integument, the wood, and the pith.

“The bark, when perfectly formed, is covered by a thin cuticle or *epidermis*,” (from two Greek words, *ἐπι* and *δερμα*, signifying an exterior skin or covering,) “which may be easily separated. It is generally composed of a number of *laminæ* or scales, which in old trees are usually in a loose and decaying state. The epidermis is not vascular, and it merely defends the interior parts from injury. In forest-trees and in the larger shrubs, the bodies of which are firm and of strong texture, it is a part of little importance; but in the reeds, the grasses, canes, and the plants having hollow stalks, it is of great use, and is exceedingly strong, and, in the microscope, seems composed of a kind of glassy net-work, which is principally siliceous earth. This is the case in wheat, in the oat, in different species of equisetum, and above all, in the rattan, the epidermis of which contains a sufficient quantity of flint to give light when struck by steel, or two pieces rubbed together produce sparks. This fact first occurred to me in 1798; and it led to experiments, by which I ascertained that siliceous earth existed generally, in the epidermis of the hollow plants.

“The siliceous epidermis serves as a support, protects the bark from the action of the insects, and seems to perform a part in the economy of these feeble vegetable tribes, similar to that performed in the animal kingdom by the shell of the crustaceous insects.”—(*Agric. Chem.* 54.)

Whether the epidermis of large trees be or be not of much importance, the microscope proves that the detached cuticle of the birch, that brown, scaly, semi-transparent membrane, which exfoliates in elastic rolled-up portions, abounds with vessels or pores, distributed in a singular net-like order; it is, in fact, one of the most beautiful microscopic objects that can be found. I am inclined, however, to hazard the conjecture that the vegetable *epidermis* performs the important function of an intermedium between the atmosphere and the denser fluids of the bark. The subject is one of extreme delicacy, and still but little understood; in fact, the agency of membranous substances when interposed between fluids of different densities, was not so much as hinted at till the experiments of M. Dutrochet led to the hypothesis of the *electrical* action exerted by vegetable and animal membrane.

I shall again refer to the subject, and in the mean time, observe, that the most extraordinary phenomena, affecting both the quantity and quality of gaseous and other fluids enclosed in bladders, have recently been noticed. I myself, have witnessed a total change in the explosive mixture of oxygen and hydrogen gases, by which the detonating property was lost within two or three hours after the gases had been passed into a bladder. The phenomena merit the most studious attention; if I mistake not, they may throw light upon another fact of very ordinary occurrence, that is, the loss which results from keeping wine “in the wood.” It is well known that, in process in time, a pipe of wine will lose several gallons, however closely it be stopped up. Now, what is it that effects this abstraction through the pores of the wood, which still afford no indication either by colour or otherwise, that any fluid had passed into or through them? Can it be any other than *that agent* which instantly renews the internal agitation of fermenting liquors that have apparently subsided into a quiescent state?

“Every part of a living plant,” says Dr. Smith, “is covered with a skin or membrane called the cuticle, which same denomination has been given by anatomists to the scarf skin that covers the animal body, protecting it from the injuries of the air, and allowing of due absorption and perspiration through its pores. The vital principle, as far as we can judge, seems to be extinct in it. The cuticle admits of the passage of fluids from within as well as from without, but in a due and definite proportion in every plant: consequently, it must be porous; and the microscope shows, what reason would teach us to expect, that its pores are different in different kinds of plants.

“The cuticle of the betony, and of many other plants, is extended into rigid hairs or bristles, which, in the nettle, are perforated, and contain a venomous fluid. On the fruit of the plum, and on many leaves, we find a blueish dry powder covering the cuticle, which is a resinous exudation; and it is difficult to wet the surface of these plants. Rain trickles over them in large drops.

“In the cork tree, the common maple, and even the Dutch elm, the cuticle is covered with a fungous substance, most extraordinary in its nature, though familiar to us as cork.”—(*Introduction*, Chap. III.)

Underneath the cuticle is a juicy and cellular substance, called the cellular integument: it is the *tissu herbacé* of M. Mirbel. The consideration of this *herbaceous tissue*, or integument, and of the *liber* or inner bark, belongs of right to that of the internal structure of plants, and it will be treated of under that head.

“The wood—*lignum* (probably from *λίκνόν*, *liknon*; derived from

λίω, *liō*, to plane, to polish: or from ὑληγόνον, *ulēgonon*, produced in the woods)—is that solid, hard substance which constitutes the main bulk of the tree. When cut across, it is found to consist of numerous concentric layers, very distinct in the fir, and other European trees in general. Each of these circular layers is externally most hard and solid. They differ among themselves in this respect, as well as in their breadth on the whole. It often happens that all the layers are broadest towards one side of the tree, so that their common centre is thrown very much out of the actual centre of the trunk.”

The outermost of these layers—that next the *liber*, or inner bark—is termed the *alburnum*, from the Latin word *album*, white; it is more succulent than the other concentric layers or *heartwood*; and constitutes that softer, less durable wood, which is termed the sap.

The *pith*—*medulla* (the marrow)—is that central internal column which is so conspicuous in many plants, particularly in the young shoots of the elder, but becomes almost obliterated in full grown trees; the texture of the pith is cellular; hence, the inquiry into its nature and offices does not belong to the present section.

244. *Various Kinds of Stems and Stalks of Plants.*—It is necessary for the sake of botanical distinction that the whole of these should be known to the botanist, although some are undoubtedly more important than others; to the gardener it may generally suffice to become accurately acquainted with the seven different kinds of stems enumerated by Linnæus. Yet the physiological student should be aware that our modern treatises enter into a much more critical view of the vegetable structure, than did the writers on Botany, at a period by no means remote: thus the stems of plants are now arranged in three chief divisions:—

1. All those trees and plants whose woody system is composed of *concentric circles*,—wherein the alburnous matter is always situated immediately within the *liber*, or inner bark, a layer of both being produced annually,—are termed *Exogens*.

2. Those vegetable bodies in which the cellular tissue is mixed up as it were with the fibrous and vascular bundles, are called *Endogens*. The stems of endogenous plants,—as, for instance, of asparagus, of the lily, the sugar-cane, among herbaceous plants, and of the palms, among trees,—have neither any proper pith, nor bark, nor wood in layers, but all are mixed together: the woody fibres are arranged in bundles amidst the spongy mass of *parenchyma*, or cellular tissue, being enclosed by a hard, and in some instances flinty, integument, which corresponds with the bark of exogenous stems.

3. The term *Acrogens* is applied to plants of the third division

which have neither bark, wood, nor bundles of vessels among cellular tissue. Cut the stalk of a frond of fern transversely, and this structure will become apparent. "The shell of the cylinder which answers to the woody part of other plants, is composed of hard plates folded upon themselves in such a manner that a section of them represents a number of sinuous lines, doubling about among spongy matter."—(See *Treatise on Botany*, with a cut, p. 18.)

Having thus introduced the reader to these new arrangements, I recur to the Linnæan enumeration, as follows:—

(1.) "CAULIS (from *καυλος*, *kaulos*, a stalk). A stem properly so called, which bears, or elevates from the root, the leaves as well as flowers. The trunks and branches of all trees and shrubs come under this denomination, also the stalks of a great proportion of herbaceous plants, especially of annuals." The stem admits of about thirty modifications in form or position, besides a great variety of superficial differences arising from the state and texture of the surface, whether it be smooth, polished, viscid, covered with hair, down, &c. &c.

(2.) "CULMUS (from *καλαμος*, *kalamos*, a reed). A straw, or culm, is the peculiar stem of the grasses, rushes, and plants nearly allied to them." It bears both leaves and flowers, and its nature is more easily understood than defined."

(3.) "SCAPUS (from *σκαπος*, *scapos*, a stalk). A stalk which springs from the root, and bears the flower and fruit, but not the leaves. *Primula vulgaris*, and *P. veris*, the primrose and cowslip, are examples of it.

(4.) "PEDUNCULUS (from *Pes—pedis*, a foot). The flower-stalk; springs from the stem, and bears the flower and fruit, but not the leaves. *Pedicellus*, (a little foot-stalk,) a partial flower-stalk, is the ultimate subdivision of a general one." Such is the foot-stalk, that supports each single flower of the cowslip, polyanthus, and of many other plants.

(5.) PETIOLUS. (The foot-stalk of leaves). "This term is applied exclusively to the stalk of a leaf; it is frequently channeled on the upper side. Sometimes it is greatly dilated and concave at the base, as in wood angelica."

(6.) "FRONS (*frons-frondis*, a leafy stalk). A frond. In this the stem, leaf, and fructification are united; or, in other words, the flowers and fruit are produced from the leaf itself, as in the fern tribe. The term frond is now used in the class Cryptogamia only." Common polypody is an example of the frond.

(7.) "STIPES (from *στυπος*, *stupos*, a stake, a trunk). A stipe is the stem of a frond, which in ferns is commonly scaly. The term

s likewise applied to the stalk of a fungus, as the common mushroom, *Agaricus campestris*."—(See SMITH'S *Introduction*, Ch. XIII.)

Modern botanists include among *stems* many of those peculiar bodies which were named tubers, bulbs, roots, &c.

The root of tulip, crocus, hyacinth, &c., is a *cormus*; it is a thickened and contracted stem, which developes the leaves. The round, massive process of the turnip-cabbage,—*Kohl Rabi*,—is a stem, and it supports the leaves on its sides. The *tuber* called potato is a very anomalous species of stem, or receptacle of buds, that elongate and produce true roots, and leaf-bearing stems, or branches.

The real *bulb* is a stem, consisting of scales, packed closely together; these are the rudiments of leaves, enclosing the parts of fructification. The *onion* is an example of the true bulb.

245. The *branches* vary little either in appearance or structure from the stems out of which they grow. The branch of a tree originates in a bud, which bud appears to proceed from a germ, that probably was formed at a period coeval with the earliest formation of the stem or branch on which it appears in the spring. On this subject there exist two or more contrary opinions. Du-Hamel, Knight, and others, supposing that every alburnous, or *fresh annual* layer of a new sap-wood, is capable of giving origin to buds and branches: while the author of the *Treatise on Vegetable Physiology*, of the *Library of Useful Knowledge*, at page 20, asserts, "That every germ is a distinct, insulated individual, the lateral progeny of the plant, generated at the period of the developement of the stem or the branch on which it appears as a bud.—That every adventitious bud, or bud appearing on an old stem or branch, originates in a germ generated at the developement of the stem or branch on which it appears, however long it may have remained latent.—That every latent germ is annually carried outwards in a horizontal direction, through every concentric layer of wood, intermediate to the pith and the surface on which it shall sprout into a branch, leaving behind it a white mark crossing every ligneous belt, by which its progress can be traced."

All plants, however, are not furnished with visible buds: these appear to be the peculiar developements of plants with woody stems. It is said that shrubs, in general, and annuals, universally, as well as all plants, the productions of the hottest climates, are destitute of buds, their leaves being produced from the bark; yet it is evident that in a vast number of shrubs a young bud is embedded in, or sprouts from the axils, or wings of the leaves—(*axilla*, from *ad* whence *axilla*, a wing.)

246. *The branches or appendages of stems*, such as down, hair, bristles, and prickles, are processes from the cellular tissue, the bark, or the wood, invested with the cuticle or epidermis. Other appendages, which have often been termed *fulcra*, props or supports, are worthy of notice, as forming botanical distinctions of some importance; such are,

(a.) *Stipula* (from *στύπος*, *stupos*, a stem, stalk, or blade of corn). “The stipula, a leafy appendage to the proper leaves, or to their foot-stalks. It is commonly situated at the base of the latter, in pairs, and is extremely different in shape in different plants.”

(b.) *Bractea* (from *βραχω*, *bracho*, a thin plate or leaf of gold, &c., which produces a crackling sound). *Bracte*, “the floral leaf, a leafy appendage to the flower or its stalk. It is of a variety of forms, sometimes green, and sometimes coloured. The *lavenders* have coloured bractees, and the purple-topped clary, *Salvia Horminum*, exhibits a gradation from the proper leaves to green bractees, and from them to coloured ones; which last are barren, or unaccompanied by flowers.”

(c.) *Cirrus*, (from *κίρρος*, *kirros*, a lock or curl of hair.) A tendril. This is indeed properly called a *fulcrum*, or support, being intended solely to sustain weak and climbing stems upon more firm and sturdy ones. By its means such climbers often reach, in tropical forests, to the summits of lofty trees, which they crown with adventitious blossoms.

The vine, *Vitis vinifera*; the various species of passion-flower, and the pea or vetch tribe, afford good examples of spiral tendrils.—(See SMITH'S *Introduction*, Ch. XVII.)

247. *The leaves*. (*Folium*, from *φύλλον*, *phullon*, a leaf.) “The leaves, the great sources of the permanent beauty of vegetation, though infinitely diversified in their forms, are in all cases similar in interior organization, and perform the same functions.

“The green membranous substance may be considered as an extension of the parenchyma, and the fine and thin covering as an epidermis. Thus the organization of the roots and branches may be traced into the leaves, which present, however, a more perfect, refined, and minute structure.”—(*Agric. Chem.* 60.)

Every leaf consists of two distinct parts; the one is that flat, expanded, membranous substance, bearing the name of the leaf; the other is the foot-stalk (*petiolus*), which connects it with the stem or twig. Leaves are much diversified in form and texture. In DR. SMITH'S *Introduction*, thirty-seven pages are occupied in describing the varieties of leaves, inasmuch as concerns situation, texture, and composition; and the Botanical Treatise in the *London Encyclopædia*

contains a list of one hundred and five varieties, under the head of *simple leaves*; of twenty-seven, under that of *compound leaves*; and of thirty-four, under the head of *determinate leaves*.

Leaves perform the most important offices in the vegetable economy; they contain sets of vessels and pores which qualify them not only to exhale redundant moisture, and the perspirable matter secreted by the plant, but also to inhale the gases of the atmosphere, and appropriate them to the perfecting of the proper juices.

The leaves are probably the organs of respiration; the health and even life of the plant depending in a great degree upon them: thus Sir Humphry Davy observes, that “the production of the other parts of the plant takes place at the time the leaves are most vigorously performing their functions. If the leaves are stripped off from a tree in spring it uniformly dies; and when many leaves of forest trees are injured by blasts, or long-continued dryness, the trees are always stag-headed and unhealthy. The *leaves* are necessary to the existence of the individual tree; the *flowers*, for the continuance of the species. The soundness of the leaves is also essential to the goodness of the *fruit*; for it is a well-known fact, that if the foliage of *gooseberry bushes* is infested by a certain small green caterpillar, the fruit invariably dwindles, is defective in size and flavour, and frequently falls off. Many remedies have been recommended; Mr. Loudon (*Encycl.* p. 4667), prefers hand picking; but when it is considered that the back of one single leaf may be tenanted by above a hundred of the caterpillars of the saw-fly (*Larvæ* of the *Tenthredinidæ*), it becomes a matter of calculation what might be the time occupied in picking off such a host of diminutive things, scarcely the size of a mite, from the greater proportion of leaves upon a hundred or two gooseberry bushes. The simple calculation by common multiplication, averaging the number of leaves, by counting those of one medium-sized tree, would possibly take up an hour or two of a person's time. My trees, for two successive years, were ruined as to fruit, by the ravages of these larvæ; we picked, and pulled, and washed, and limed, and fumigated with sulphur, burning it in a flower-pot saucer under the bush;—nothing availed. At length, in the third year, I boiled a quantity of the pith of *colocynth*, or bitter apple, in water, and with a brush flirts the cold liquor over the leaves, the under sides particularly, as well as I was able, while another person held up the branches. Whether this bitter dose effectually destroyed the enemy, or so molested him, as to cause him to quit his quarters, I cannot exactly say; but certain it is that I *saved the leaves and fruit that third year*; and three years subse-

quently elapsed without a recurrence of the visitation. To prepare the infusion, take a quarter of a pound of the pith, boil it in a gallon and a half of soft water till it be reduced to one gallon; strain the liquor through a hair sieve, press the pulp, and pour over it as much cold water as will make up the quantity to one gallon.

248. *The Inflorescence* (*Inflorescentia*, from *In*, and *floresco*—to produce flowers in a certain form or order) is a term used by Linnaeus, to express the particular manner in which flowers are produced. It includes eleven modes or forms, that are fully detailed in the eighteenth chapter of Dr. SMITH'S *Introduction*. They are as follow:—

(a.) VERTICILLUS,—a *whirl* or *whorl*.—"In this the flowers surround the stem in a sort of ring; though they may not, perhaps, be inserted on all sides of it, but merely on two opposite ones, as in Dead-nettle *Lamium*" (derived, it may be, from *λαμια*, *lamia*, a sorceress, from *λαιμος*, *laimos*, the throat, indicating the gaping form)—some of the mints, *Mentha*, &c.

(b.) RACEMUS (possibly from *ράξ*, *ράγος*, a *grape-berry*).—"A Cluster, or Raceme, consists of numerous, rather distant flowers, each on its own proper stalk, and all connected by one common stalk—as a bunch of currants, *Ribes rubrum*.

(c.) SPICA (an *ear of corn*).—"A spike bears numerous flowers, ranged along one common stalk, without any partial stalk"—as in the greater plantain, *Plantago major*; lavender, *Lavandula spica*; spiked veronica, *Veronica spicata*. *Spicula*, a spikelet, is a term applied to the grasses that have many florets in one calyx. Such florets are ranged on a little foot-stalk, and thus they form part of the flower, and not of the inflorescence. Reedy sweet grass, *Glyceria*—formerly *Poa aquatica*—is an example.

(d.) CORYMBUS (from *κόρυμβος*, *korumbos*, the head or top of plants, a bunch or clustre of ivy-berries).—"A Corymb is a spike, whose partial flower-stalks are gradually longer as they stand lower on the common stalk, so that all the flowers are nearly on a level; of which *Spiræa opulifolia*, a common shrub in the gardens, is an excellent specimen." Another may be found in the common pearl-blossom, *Pyrus communis*.

(e.) FASCICULUS (from *fascis*, a bundle of twigs).—"A fascicle is applied to flowers on little stalks, variously inserted and subdivided, collected in a close bundle, level at top—as the sweet-william, *Dianthus barbatus*."

(f.) CAPITULUM (from *caput*, the head, adding the diminutive—*ulum*, meaning a little head).—"A head or tuft, bears the flowers sessile" (without partial foot-stalks, *Pedicelli*, 243-4), "in a globu-

lar form"—as *Globe amaranthus*, *Gomphrena globosa* and *Buddlea*, *Buddlea globosa*.

(g.) UMBELLA (a little shade, an umbrella, a covering from the sun).—An Umbel or Rundle.—“In this several flower-stalks or rays, nearly equal in length, spread from one common centre, their summits forming a level, convex, or even globose surface, more rarely a concave one. When each ray is simple, or single-flowered, it is called a simple umbel—as those of cowslip and oxlip, *Primula veris*, and *elatior*. In the compound umbel, each ray or stalk bears an *umbellula*, or partial umbel, as in the common carrot, *Daucus carota*; celery, *Apium graveolens*, &c.”

(h.) CYMA (from  $\chi\hat{\upsilon}\mu\alpha$ , *kuma*, a young shoot of cabbage).—“A cyme has the general appearance of an umbel, and agrees with it so far that its common stalks, all spring from one centre, but differs in having those stalks variously and alternately subdivided. Examples are found in common laurustinus, and also in elder, *Sambucus niger*. This mode of inflorescence agrees with a corymbus also, in general aspect; but, in the latter, the primary stalks have no common centre, though the partial ones may sometimes be umbellate; which last case is precisely the reverse of a cyme.”

(i.) PANICULA (from *panus*, gossamer, or millet, panic, reeds, &c. *Panicula* may be derived from  $\pi\alpha\nu\omicron\varsigma$ , *panos*, a torch, a candlestick; or, more probably, from  $\pi\alpha\nu\iota\kappa\omicron\varsigma$ , *panicos*, fear, indicating the quaking, wavy structure of the inflorescence).—“A panicle bears the flowers in a sort of loose, subdivided bunch or clustre, without any order. When the stalks are distant it is called *diffusa*, a lax or spreading panicle—as in *Saxifraga umbrosa*, London-pride, but particularly in many grasses, as the common cultivated oat, and *Avena strigosa*, bristle-pointed oat. In this tribe the branches of the panicle are mostly semi-verticillate: the common reed, *Arundo phragmites*, furnishes a most beautiful and ornamental specimen of a compound panicle; when ripe, it is brownish and grayish-purple, drooping and waving in the wind.

(k.) THYRSUS (from  $\theta\acute{\upsilon}\rho\omicron\varsigma$ , *thursos*, a sprout, stem, or stalk; a spear surrounded with garlands of ivy, carried by the Bacchanals).—“A bunch is a dense or close panicle, more or less of an ovate figure, of which the lilac, *Syringa vulgaris*, and butterbur, *Tussilago petasites*, are examples cited by Linnæus.” Dr. Smith thinks that a bunch of grapes is a specimen of a true *thyrsus*, “to the characters of which it correctly answers.”

249. A *Flower* is divided into several parts; namely the Calyx, or flower-cup; the Corolla, or blossom; the Stamina, or male organs; the Pistillum, or pointal; the Pericarpium, or seed-vessel; the

Semen, or seed ; and the Receptaculum, or receptacle. These parts admit of several divisions, which will now be concisely described.

250. CALYX (from *καλυξ*, *kalux*, the case of a flower).—The flower-cup is that external covering, usually of a greenish colour, which invests and protects the coloured floral leaves, or corolla, where that is present ; or those principal and most important organs of fructification, the stamens and seed-vessel, where the corolla is wanting.

The Calyx is sometimes absent, and therefore is not absolutely essential to the perfecting of the fruit. It is distinguished by different appellations, and was by Linnæus originally divided into seven distinct kinds. The following is Dr. Smith's arrangement:—

(1.) PERIANTHIUM (from *περι*, *peri*, about, and *ανθος*, *anthos*, a flower) is “a calyx, properly and commonly so called, when it is contiguous to, and makes a part of, the flower, as the five green leaves which encompass the rose, including their urn-shaped base.”

(PERIGONE is a term introduced as one of the modifications of Calyx ; it appears to be derived from *περι*, *about*, and *γενω*, *pevω*, the *parent*, or *generator* ; it invests the seed-vessel, and frequently is highly and beautifully tinted.)

(2.) INVOLUCRUM (from *involveo*, to enclose or wrap up),—an involucre or wrapper.—“This is remote from the flower, and can scarcely be distinguished clearly from a *Bractea*.”—(See 245-b.)

“The term was first adopted by Linnæus at the suggestion of his friend Artedi, in order to distinguish the *genera* of the umbelliferous plants, for which purpose the latter deemed the part in question very important.” Dr. Smith has subsequently abandoned this distinction, as appears by his notice of the umbelliferous tribe, in the last edition of his English Flora.

(3.) AMENTUM (I can find no other translation to this term than that of “a strap, to which javelins were tied to throw them with greater violence ;” however, one of the terms used by authors prior to Linnæus, *nucamentum*, from *nux*, *nucis*, a nut, seems to furnish an idea of the original meaning of the word as understood by botanists), a catkin ; it consists of “a common receptacle of a cylindrical form, beset with numerous scales, each of which is accompanied by one or more stamens or pistils, so that the whole forms an aggregate flower. The receptacle itself, and the bases of the scales, are firmly united, and the whole catkin falls off entire, except that in some instances the upper part of each scale withers away, as in the willow genus.” The common hazel-nut furnishes an example of the catkin as respects the male blossom only : *Humulus*, the hop, has a catkin for the female or fertile flower.

(4.) SPATHA (a sheath or scoop, from *σπαθη*, *spathē*, a branch of a palm), “a covering which bursts longitudinally, and is more or less remote from the flower.” One of the most familiar examples of the spatha is to be found in the common *arum*, vulgarly called “lords and ladies;” this also contains the fructification on a *spadix* (from *σπαδιξ*, *spadix*, a palm-branch with the fruit on it), or lengthened receptacle, “according to the genuine Linnæan idea of this kind of calyx, taken from palm-trees.”

(5.) GLUMA (a husk).—The calyx of grasses, corn, and grass-like plants of a chaffy nature, the one usually enclosing and enfolding the other, as in quaking-grass, *Briza*.

(6.) PERICHÆTIUM.—“A scaly sheath, investing the fertile flower, and consequently the case of the fruit-stalk, in some mosses.”

(7.) VOLVA (from *volvo*, or *involve*, to wrap), “a wrapper or covering of the Fungus tribe, of a membranous texture, concealing their parts of fructification, and in due time bursting all around, forming a ring upon the stalk, as in *agaricus campestris*, the common mushroom.”

It must not be overlooked that modern botanists have established the fact that, when a single *integument only* invests the parts essential to fertility; *that covering* is considered as a *calyx*, never as a *corolla*. A true *corolla must* be situated within an external covering: *colour* is now a secondary consideration; and therefore, the following definition of corolla must be received with some qualification.

251. The COROLLA (from *coronella*, a little crown).—The corolla is that part of the fructification which is universally admired on account of the beautiful colours it displays, and the fragrance it exhales. Like the calyx, the corolla is not absolutely essential to fertility, for it frequently is absent. “The term includes two parts, the petal, *Petalum*; and the nectary, *Nectarium*. The former is either simple, as in the primrose, in which case the corolla is said to be monopetalous” (from *μονος*, *monos*, one, and *πεταλον*, *petalon*, a leaf—flower-leaf), “of one petal; or compound, as in the rose, in which it is polypetalous,” or composed of several petals (from *πολυς*, *polus*, many, and *πεταλον*). This part of the fructification admits of an almost infinite variety of forms, and modes of construction: it is called *regular*, if, as in the rose, primrose, and pink, it be uniform in figure; and *irregular*, when it is unequal, as in the columbine and violet. Among the irregular corollas, the most remarkable kinds are the *ringent*, or gaping, as dead-nettle; the *personate*, with a mouth or palate, as toad-flax or snap-dragon, and the *papilionaceous*, (from *papilio*, a moth or butterfly,) of which, the leguminous tribe of plants, peas, beans, vetches, clover, &c., present familiar examples.

(2.) *Nectarium* (from *Νεκταρ*, *nectar*).—The nectary, or honey-cup, is that part of the corolla which produces honey. The precise part, or secreting gland, is not always traceable, but as Dr. Smith observes, “It is perhaps nearly universal, as hardly a flower can be found that has not more or less honey, though that liquor is far from being universally, or even generally, formed by any apparatus separate from the petals. In monopetalous flowers, as *Lamium album*, white dead nettle, the tube of the corolla contains, and probably secretes the honey, without any evident nectary. Other instances of nectaries in the claws of petals, are found in the crown imperial and lily; which only confirms more strongly the compendious construction of the lily tribe, the leaves of their flowers in these examples being calyx, petals, and nectaries, all in one.—(*Introd.* p. 266.)

In the cruciform plants (those of the 15th class), stocks, wall-flowers, and the like, the nectary is a gland at the base of the stamen; in larkspur, it is the spur; and the same in the orchis tribe; at least, these spurs are the depositaries of honey, if they are not the secreting organs; and this is particularly the case in *Orchis bifolia*, butterfly orchis, a flower whose delicious odour at night rivals that of the honey-suckle; and the spur contains a large portion of liquid honey, which can be pressed out at the lip of the nectary.

252. STAMINA—(from *στάμων*, *stámōn*, yarn, or spun wool, a term intended, most likely, to express the capillary, hair-like, or woolly appearance, of this part of the flower,—or it may be derived from *σταμινες* *Stamines*, erect pieces of wood). “The stamens, formerly called the chives, vary in number in different flowers, from one to some hundreds. Their situation is internal with respect to the parts we have been describing; external to the pistils, at least in simple flowers;” so it is in compound flowers of the class syngenesia, inasmuch as concerns the florets of the disk, that part which is commonly of a yellow colour (as in daisy, chamomile, &c.), each separable portion of which is a true and perfect flower, consisting of a tubular corolla, divided at the top into five segments, five stamina, a pistillum, and a perfect seed; unless where nature sports, and changes the fertilizing organs into strap-shaped petals, in which case, the flower becomes double and barren.

The stamina “are essential, there being no plant hitherto discovered, after the most careful research, that is destitute of them, either in the same flower with the pistils, or in a separate one of the same species. A stamen commonly consists of two parts, the filament, *Filamentum*, and anther, *Anthera*, the former being merely what supports the latter, which is the only essential part.” The

filaments are threads, those taper bodies which are immediately within the flower-leaves; these threads support the *antheræ*, (tips or summits,) the only essential parts of a stamen; they are "generally of a membranous texture, consisting of two cells or cavities, bursting longitudinally, at their outer edges, as in the tulip; and then becoming so changed in figure, as scarcely to be recognised for the same plump and well-defined bodies which formed the summit of the stamina.

"The *pollen*, farina, or dust," (from *pello*, to drive away,) "is contained in the anther, from which it is thrown out chiefly in warm dry weather, when the coat of the latter contracts and bursts. The pollen, though to the naked eye a fine powder, and light enough to be wafted along by the air, is so curiously formed, and so various in different plants, as to be an interesting and popular object for the microscope. Each grain of it is commonly a membranous bag, round or angular, rough or smooth, which remaining entire till it meets with any moisture, being contrary in this respect to the anther, then it bursts with great force, discharging a most subtile vapour."—(*Introd.* 272.)

It is said that the pollen contains *hydrogen gas*, and being thus rendered specifically lighter than atmospheric air, it floats therein till it lights on the medium which it is prepared to impregnate. If this be the fact, it will be interesting to investigate it as a phenomenon of attraction, and subject to the influence of that law by which bodies in opposite states of electricity tend to form a union one with the other. In this view of the subject, the pollen, it is probable, will never explode, and consequently, will fail to impregnate the organs of any germen which does not attract it by the agency of a gas or fluid in a specifically opposite state of electricity. But should the dust approach an organ possessing and exerting such a specific energy on the gas contained in the inembranous bag, it will burst, and produce a new arrangement of the chemical elements of the embryo seed in the germen. The *gaseous* theory will throw some light upon the phenomenon of the mixtures and crossings which take place in the cabbage tribe, and among individuals of congenerous species; and by assuming that specific attractions must take place before any impregnation can be effected, it will evince the utter impossibility of a general and promiscuous fertilization, which were it not provided against, would produce the utmost confusion among the genera and species of plants; the theory and the fact bear out each other, and daily experience proves *that* which the hypothesis presumes.

*PISTILLA* (from *pistillum*, a pestle; from the resemblance, doubt-

less, of the organ to that utensil). The pistils, or pointals, are not less essential than the stamina; they stand in the centre of the flower, and usually are fewer in number. Sometimes the pistil is not in the same flower as the stamens, and then it does not always occupy the centre of the flower. Every pistil consists of three parts.

(1.) The *germen*—this is essential, as it is the rudiment or matrix of the seed or fruit.

(2.) *Stylus*, the style (from *στυλος*, *stulos*, a stalk, or sharp-pointed pencil). This part is sometimes wanting; it also varies exceedingly in length and thickness; it is a pillar or column to support the third part or *stigma*, (from *στιγμα*, *stigma*, a mark or brand,) the upper part or termination of the style; or if that be absent, the crown of the germen. “Its shape is various, either simple, scarcely more than a point; or capitate, forming a little round head; or variously lobed. Sometimes it is hollow and gaping, more especially when the flower is in its highest perfection; very generally downy, and always more or less moist, with a peculiar viscid fluid, which, in some plants, is so copious as to form a large drop, though never big enough to fall to the ground. The moisture is designed for the reception of the pollen, which explodes on meeting with it; and hence the seeds are rendered capable of ripening, which, though in many plants fully formed, they would not otherwise be.—(*Introd.* 274.)

If a blossom of the peach-tree, in perfect bloom, be placed under a powerful magnifying glass, the stigma will appear to be covered with slight prominences and excavations; it is rough and reticulated. The farina, or pollen, discernible in some of the adjoining open cells of the anthers, resembles small roundish eggs, each, apparently, of a size to fill one of the indentations of the stigma. Whether this be the mode in which nature effects the fertilizing of the peach-germ or not, the structure is altogether most curious and interesting, and merits patient and attentive observation.

253. PERICARPIUM (from *περι*, *peri*, round about; and *καρπος*, *karpos*, fruit). The seed-vessel; an envelope or covering enclosing the seed; it is the impregnated germen enlarging, or expanded to maturity. It is not essential, as in many flowers, the seeds are naked, being simply protected by the calyx. Such is the case with the ringent flowers of the 14th class, *Didynamia*, and with many others. “The use of the seed-vessel is to protect the seeds till ripe, and then, in some way or other, to promote their dispersion, either by its elastic power” (as in yellow balsam, *impatiens*, *noli me tangere*) “or serving for the food of animals, in whose dung the seeds

vegetate." This is said to be the fact with respect to that beautiful and odoriferous tree, *Myrtus pimenta*, or the true all-spice. The berries of this tree are devoured by birds, and thus are prepared for vegetation; which takes place rapidly, after the seed has undergone this stimulating process. There are several kinds of seed-vessels, which may be shortly described as follows:—

(a.) *Capsula*, (meaning a little casket, or box.) "A capsule is a dry seed vessel of a woody, coriaceous, or membranous texture, generally splitting into several valves; more rarely discharging its contents by orifices or pores, as in *Campanula*, (bell-flower,) and *Papaver*, (poppy,) or falling off entire with the seed."

(b.) *Siliqua*, (from *ξύλικη*, *xulike*, wooden, as a kernel,) a pod—"a long, dry, solitary seed vessel of two valves, separated by a linear receptacle, along each of whose edges the seeds are ranged alternately." This is exemplified on drawing asunder the two sides of a pod of a stock, or wall-flower; a thin integument occupies the middle, and on this integument, or receptacle, the seeds lie in alternate order.

*Silicula*, a pouch, or little pod, is only a different sort of a pod, being of a short or rounded figure, as whitlow-grass, *draba*.

(c.) *Legumen*, (derived from *lego*, to pull or gather.) "A legume is the peculiar solitary fruit of the pea kind, formed of two oblong valves, without any longitudinal partition, and bearing the seeds along one of its margins only.—In trefoil, *trifolium*, the legume of several species produces only a solitary seed.

(d.) *Drupa*, (*δρυπεψ*, *drupeps*, as a fruit ripened on the tree.) "A drupe, or stone-fruit, has a fleshy coat, not separating into valves, containing a single, hard, and bony nut, to which it is closely attached; as in the peach, plum, cherry, &c.

(e.) *Pomum*, (from *πωμα*, *poma*, drink; the name indicating juiciness.) "An apple has a fleshy coat, like the *drupa*, but containing a capsule with several seeds, as in common apples and pears."

The capsule is that coriaceous vessel of several cells, containing the pips, which is usually called the "core;" it is sometimes very difficult to distinguish between a true *pome*, or apple, or some kinds of berry—as the mountain ash-berry, and the hawthorn.

(f.) *Bacca*, (perhaps from *βακχος*, *bacchos*; a berry, as of the grape, or other fruit, productive of intoxicating liquors.) "A berry, is fleshy, without valves, containing one or more seeds, enveloped with pulp. It becomes more juicy internally, as it advances to maturity, quite contrary to the nature of a capsule, though the difference between these two unripe fruits may not be discernible,

and though some true berries, when fully ripe, finally become of a dry and spongy texture; but they never open by valves, or any regular orifice." Examples of a *simple* berry, are found in the currant, *ribes*; the grape, *vitis*; and in bitter-sweet, *solanum dulcamara*. A compound berry, *bacca composita*, is shown in raspberry, blackberry, and other species of the genus *Rubus*; the individual grains of which are termed *acinus*, a stone, or kernel, (derived from *akis*, *akis*: a point, applied, perhaps, particularly to a grape-stone, because of its pointed extremity.)

The orange and lemon are true berries, with a thick coat; the cucumber and melon are of a tribe which produces a sort of berry, termed *gourd*, with the seeds situated in the sides and not the centre of the fruit. "There are several spurious kinds of berries whose pulp is not properly a part of the fruit, but originates from some other organ. Thus, in the mulberry, the calyx, after flowering, becomes coloured, and very juicy, investing the seed like a genuine berry."

(*g.*) *Strobilus*, (from *στροβίλος*, *strobilos*, a whirl, a cone of a pine.) A cone, or catkin, hardened and enlarged into a seed-vessel, as in *pinus*, the fir.

254. SEMINA.—The seeds consist of several parts; some of these are essential to the being of the future plant; others, subservient to the purpose of dispersing or conveying the seeds from the plant in which they were produced, to a spot favourable to the future development of the embryo plants. Of the parts more immediately essential to growth, the first to be noticed is the

(1.) *Embryo*, or germ, (from *Εμβρυω*, *Embruō*, to sprout out,) is that small plantlet enclosed between the seed-lobes of most seeds, and which is very conspicuous in the garden broad bean, and in the seed of the ash, if it be softened in luke-warm water for a few hours.

(2.) *Cotyledones*, (from *κοτυλη—κοτυληδών—kotuledōn*.)—Cotyledons, or seed-lobes, fitting one into the other as a bone into its socket; they are commonly two in number, and are immediately attached to the embryo, of which they doubtless form the nourishment, till the young plant has established its roots in the soil. The cotyledons are those portions of a seed, of a farinaceous substance, which, in a *bean* for instance, are situated immediately under the skin, and constitute its principal bulk. They frequently emerge, with the plumet, from the soil, and then are known as the seed-leaves. Plants in general, are furnished with two seed-lobes, and they are then termed *Dicotyledonous* plants; others, which have but one seed-lobe, are termed *Monocotyledons*: among these are the

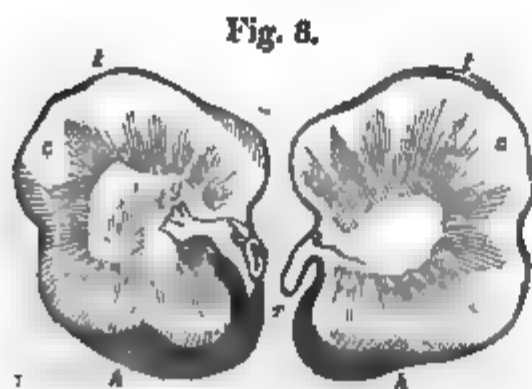
grasses, including the various species of corn, the palm-tribe, &c. The pines and firs, and some other genera, have more than two seed-lobes; and these are called *Polycotyledonous* plants. These terms are derived from Greek words of number—*μονος*, *monos*, one; *δι*, *di*, two; *πολυς*, *polus*, many—joined to *κοτυληδων*—forming *μονο-cotyledon*, &c., &c.

(3.) *Albumen* (from *album*, white)—The white, Dr. Smith observes, “is a farinaceous, horny substance, which makes up the chief bulk of some seeds—as grasses, corn, palms, lilies, never rising out of the ground, nor assuming the office of leaves, being destined solely to nourish the germinating embryo till its roots can perform their office.” In some plants it is wanting; in others, which even possess cotyledons, it is present; in every case, it appears to be an organ of nutrition.

(4.) *Vitellus*—the yolk—where present, exists in the form of a scale, between the embryo and albumen: to the latter it is adapted, but can be separated from it; but to the embryo, it is attached by incorporation, and cannot be separated without a disruption of parts. In *Zea*, Indian corn, the albumen and vitellus become very apparent, after the seed has been deposited in the soil for a few days. The vitellus, or yolk, is supposed to constitute the bulk of the seed in mosses, ferns, and some other genera. Dr. Smith believes that its true office is to perform the function of a cotyledon, with regard to air, if not to light, till a real leaf can be sent forth. It does not emerge from the ground, but like the albumen, appears to be absorbed during the progress of the embryo.

(5.) *Testa*.—The skin, or integument of the seed, which covers and encloses it, and is frequently double; “it contains all the parts of a seed above described, giving them their due shape, for the skin is formed, while they are but a homogeneous liquid. It differs in thickness and texture, in colour and appearance, in different plants. It is frequently double; that is, an exterior or tough leathery skin

or integument, is lined with a finer and more delicate membrane: both are discernible in the walnut, in the kernels of the peach, almond or plum; and very plainly in the common garden bean; where *t t*, fig. 8, show the *testa*; *c c*, the two *cotyledons*, or seed-lobes: *g*, the germ or embryo, the plumule which will



become the young plant: *r*, the radicle, or the first process of the young root; and *h h*, the hilum.

(6.) The *Hilum*, or scar, is the point by which the seed was attached to its receptacle, and through which, the nourishment was conveyed to the seed during the process of maturation. “When the seed is quite ripe, the communication through this channel is interrupted: it separates from the parent plant without injury, a *scar* being formed on each. Yet the *Hilum* is so far capable of resuming its former nature, that the juices of the earth are imbibed through it, previous to germination.”

Seeds are frequently furnished with appendages, some of which are evidently designed to act as sails, whereby they may be transported to a spot remote from that where they were grown, such are:—

(1.) *Pappus* (from *παππος*, *pappos*, a down or feather,) as in the seed of the dandelion, goat’s-beard, and the thistle.

(2.) *Cauda*, a tail, as in virgin’s bower—*Clematis*.

(3.) *Rostrum*, a beak, as in Geranium, — Venus’s comb — *Scandix*.

(4.) *Ala*, a wing, a dilated membrane, as in the fir or pine tribe, the maple, *Acer*; ash, *Fraxinus*, &c. Seeds are usually plain and smooth, but they are sometimes furnished with spines, hooks, prickles, or scales, as in the carrot, parsnep, goose-grass, and bur-dock.

255. *Receptaculum*.—The receptacle, the base, or point of connexion of the other parts of fructification: it is that part which sustains the seed; that part of the artichoke, for instance, which is eaten, after the choke is removed, and which thus affords an excellent familiar example of the receptacle of compound flowers,—a class, in which this part is very readily distinguishable. In the daisy it is conical, in chrysanthemum, convex; in dandelion convex also, and very closely resembling white leather, dotted with slight punctures; in some flowers it is plain, in others chaffy, and frequently it is covered with down or hairs. In general, the receptacle may be described as that part of a flower which remains, after pulling off the calyx, corolla, stamina, and pistillum; it is the upper termination of the stalk—that base, or pediment, from which the other parts are raised, and upon which they rest.

The foregoing are the external organs of plants. I have made great use of, and laid peculiar stress upon, the authority of the late Sir J. E. Smith; and to his able *Introduction*, the reader, who wishes to obtain more particular information of the structure of plants, is referred. Enough, probably, has been advanced, to furnish something of a general knowledge of those parts which can scarcely fail to come under the observation of every person who cultivates a

rod of garden-ground; for if he only raise a cabbage-plant, or gooseberry-bush, he may trace the greater part of them; and if moreover, he possess an inquiring and reflective turn of mind, he will discover that, “vegetables are organized beings supported by air as food, endowed with life, and subject to death as well as animals; that they are sensible to the action of nourishment, air, and light, and either thrive or languish, according to the wholesome or hurtful application of these stimulants;” and consequently, that they *must* possess an *internal* structure, a vascular system, wherein, as in the human frame, the processes of elaboration and distribution are uninterruptedly carried on, till at length the plant, which had been only an embryo in the seed, attains its full size, and arrives at maturity.

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## SECTION II.

### PART I.

#### NATURAL HISTORY AND CULTIVATION OF ESCULENT VEGETABLES.

Subject 1. SEA-KALE:—*Crambe Maritima*; *Cruciferae*. Class **x** *Tetradynamia*, of Linnæus.

256. *Sea-kale* is a hardy perennial, a native of various parts of the shores of Britain. Its essential generic character, according to the *English Flora*, is,—“a *pouch* globose, stalked, coriaceous, of one cell, without valves; deciduous; seed solitary.”—“It is herbaceous or somewhat shrubby; leaves rather succulent, toothed or pinnatifid; rounded, sinuated, waved, toothed, glaucous, very smooth, as well as the stem.” The flowers are borne in corymbose clusters; they are of a beautiful milk-white; with a tint of yellow near the mouth: and have a sweet or honey-like, and fragrant odour.

The plant has not long been introduced into public use as a dinner vegetable. The *Encyclopædia of Gardening*, at No. 3898, says that “Jones, of Chelsea, assured the late Mr. Curtis that he saw bundles of it, in a cultivated state, exposed for sale in Chichester-market, in 1753. About the year 1767, it was cultivated by Dr. Lettsom, at Grove-hill, and by him brought into general notice in the neighbourhood of London.” In France it has been but little known. Sea-kale is described as an *asparaginous* plant; and, in some respects, it is treated as asparagus—that is, it is bleached or blanched, and then boiled like that vegetable, which in taste it

somewhat resembles; or, rather, it blends the flavour of asparagus with that of the cauliflower or white broccoli: but, in its growth, it is much more like celery than asparagus; and, with respect to botanical character, it is more nearly allied to the brassica, or cabbage-tribe. Sea-kale is a choice and delicate vegetable, is of the most ready culture, and bears forcing remarkably well.

257. *Soil and Propagation*.—Being a native of the sandy sea-coast, a light sandy soil is indicated, which should be assisted with vegetable compost, and probably with sea-salt. Maher says, “Prepare the ground in December or January, by trenching it two feet and a half deep; if not that depth naturally, and light, it must be made so artificially, by adding a due proportion of fine white sand, and very rotten vegetable mould. If your ground is wet in winter, it must be drained effectually, so that no water may stand within a foot at least of the bottom; for the strength of your plants depends on the dryness of the bottom, and the richness of your soil. Then divide the ground into beds four feet wide, with alleys of eighteen inches; after which, at the distance of every two feet each way, sow five or six seeds two inches deep, in a circle of about four inches in diameter. This operation must be performed with strict care and regularity, as the plants are afterwards to be covered with blanching-pots, and both the health and beauty of the crop depend upon their standing at equal distances. In the months of May and June, if the seeds are sound, the young plants will appear. When they have made three or four leaves, take away all but three of the best plants from each circle, planting those you pull up (which by a careful hand may be drawn with all their tap-root) in a spare bed for extra forcing, or to repair accidents.”

Sea-kale may be raised, as has been seen, from seeds, either by sowing it, as directed for asparagus-seeds (149), in beds, where it is to remain, or in others from which it is to be transplanted. In the latter case, two ounces will be sufficient for a seed-bed four feet by nine, in which the rows are twelve inches asunder, and the seeds at eight inches apart in the rows. If, however, the seed be sown to remain, the same quantity will serve for a bed of five feet by fifteen, the seed being sown in drills at two feet apart every way.

Plantations may be formed early in April, by taking off rooted offsets from established plants, or by cuttings from the roots, with two or three eyes to each cutting. Sowing is greatly to be preferred to planting. A bed or plot, *sown*, retains all its plants safe, and they become strong, very rapidly: transplanting, though it may be successfully performed, is a debilitating process, from which the sea-kale does not speedily recover so as to acquire that depth of root,

and vigour of plant, which characterize the undisturbed seedling: I never yet saw the rows of the latter fail, but numerous blanks frequently occur when the roots have been disturbed. Something however must be allowed for difference of soil. Dig and trench the ground to the depth of at least twenty inches, lay six inches of seaweed, or vegetable compost, at the bottom of each trench; add a large portion of sandy soil, or pure sand, so as to raise the bed to the full depth of two feet of good light earth. If the bed be formed six feet wide, plant three rows of cuttings or offsets; that is, one row in the centre, and two other rows, one on each side of the middle one, and two feet from it. These three rows will occupy four feet, and leave a foot of earth on both sides of the outer rows. Plant the sets eighteen inches asunder in the row, and so deep as to allow of the upper part or crown being at least two inches below the surface of the ground. Make the bed perfectly level, and cut its edges even, and form alleys, as directed for asparagus (156). Keep it free from weeds at all times; and in two years from the time of planting, some good kale may be cut for use.

Abercrombie says,—“A fit soil for it may be prepared of one-half drift-sand, two-sixths rich loam, and one-third small gravel, road-stuff, or sea-coal ashes.”

258. *Future Culture*.—Maher gives the following directions for the cultivation of sea-kale, subsequent to the forming of the beds in the early part of the year:—“In the following November, as soon as the leaves are decayed, clear them away, and cover the beds an inch thick with fresh light earth and sand, that has lain in a heap and been turned over at least three times the preceding summer: this, and indeed all composts, should be kept scrupulously free from weeds, many of which nourish insects, and the compost is too often filled with their eggs and grubs. Upon this dressing of sandy loam, throw about six inches in depth of light stable-litter, which finishes everything to be done the first year. In the spring of the second year, when the plants are beginning to push, rake off the stable-litter, digging a little of the most rotten into the alleys, and add another inch in depth of fresh loam and sand. Abstain from cutting this year, though some of the plants will probably rise very strong, treating the beds the succeeding winter exactly as before. The third season, a little before the plants begin to stir, rake off the winter covering, laying on now an inch in depth of pure sand or fine gravel. Then cover each parcel with one of the blanching-pots, pressing it firmly into the ground, so as to exclude all light and air; for the colour and flavour of the sea-kale is greatly injured by being exposed to either.”

Barton (from the *Caledonian Hort. Mem.*), "in the autumn, covers all the sea-kale (excepting the roots intended to be taken up for forcing) with leaves, as they are raked from the pleasure-grounds; covering each bed in thickness according to the strength and age of the roots, giving the greatest covering to the oldest, upon an average from five inches to a foot when first laid on." He then lays over the leaves a covering of long dung, just sufficient to prevent the leaves from being blown away. The advancing heads press up the covering, so as to be easily perceived, and they are then cut without removing more of the covering than that about the heads to be cut. He defends the practice of cutting one-year-old plants as not being injurious. After the kale is all taken, he removes the coverings, and digs the ground regularly over.—(*Encyc. of Gard.* 3902-3.)

In October or November, when the leaves decay, pull them off, and carry them to some waste ground, or the compost heap. Clear the surface entirely of weeds, fork it lightly, and cover it all over with sandy earth and decayed leaves, just deep enough to conceal the crown. Set up a marking-stick at the centre of each plant, prior to covering the bed.

259. *Blanching and Cutting the Sea-Kale.*—If no forcing be attempted, the sea-kale will, in all probability, be in season from the last week in March to the end of April, allowing for the state of the weather, and the age of the plants, the strongest shoots coming in the first. Early in February, and even in January, if the weather be open, and appearances promise an early spring, examine each head to see that it is sound—the little marking-sticks will point out the precise situation—and over the centre of each sound root place a very large-sized flower-pot, the hole of which is closed with a cork; but give the preference to a proper sea-kale pot, with its cover. Small tubs or boxes, a foot in diameter every way, will do. Press the vessel firmly into the soil; and, if tubs be used, cover the whole with mats, to exclude the light, the influence of which it is, that gives colour to the plant. Raise the covers now and then, to see if the heads come on, and remove slugs or other vermin. If these appear, sprinkle quick-lime dust around the plants, three or four inches from each: also at the outside of the pots. In common seasons, the kale, it is probable, will in succession attain the height of from six to eight inches, being of a clear milk white, the tips and upper edges of which are tinted with a fine purplish crimson: these are the incipient leaves, among which are sometimes to be seen the young yellowish, corymbose clusters of flowers. The whole forms as beautiful an object as can be well conceived; and this is the sea-kale

in perfect condition, and ready to be cut for use. Remove the shoot with a clean cut, close to, but not below, the part where the leaf-stalk joins the head; it is narrower there; and, to make sure of the operation, remove the soil from around the stem, and the proper place will be apparent. When the sea-kale is cut, remove the pot or covering from that root; and when all the shoots are taken, cut the plant over, just above the crown, with a long sharp knife. Add a coating of well-decayed vegetable compost, or leaf-mould, to the depth of two or three inches; and then dig the bed carefully; cut the edges, and keep it constantly free from weeds.

260. *To Force Sea-Kale*.—Pursue the same method, but fill in all the spaces between the pots with stable dung, which has been prepared for some time, and add a covering of the same over the tops of the pots, and a lining about the sides of the beds. The dung must not be hot: it is to be turned repeatedly, till the heat be found not to exceed  $55^{\circ}$  or  $60^{\circ}$ . Thus, Maher observes, “that the only thing necessary in forcing sea-kale, is to be very particular in guarding against too much heat, using trial-sticks, and never, if possible, exceeding  $55^{\circ}$ .” Abercrombie, Nicol, and Maher, recommend forcing in the open air. The former directs to begin the work seven weeks before the plants be wanted. The beds are to be set in order, the surface to be moved, and two or three inches of a mixture of coal-ashes, fresh light earth, and drift-sand, to be spread over it. Dung, which has been prepared for three weeks, either alone or mixed with tree-leaves, is to be placed all around, about, and over each pot, extending eight or ten inches beyond and above the pots. These are to be examined frequently, and the heat attended to. “If the heat be under  $50^{\circ}$ , there is not enough to excite the plants; and if above  $60^{\circ}$ , it is too fiery, and may injure them. In about three weeks or a month after being covered up, the first shoots will be from six to ten inches long, and fit for the table. If the plant send up a flower-stalk, cut it away; and successive supplies of shoots will be produced, till perhaps the end of the third month from beginning to force.”

In dressing sea-kale beds, avoid sea-coal ashes. Many persons have lost *half* their plants by the injudicious application of this material, which, as we perceive, was formerly much in vogue.

261. Baldwin forces sea-kale where it stands in the open garden, in the following manner. “On each side of a three-feet bed, in which the sea-kale has been planted, trenches are formed two feet deep, and eighteen inches wide at the bottom. The side of the trench next to the bed is perpendicular, and the other side is sloped, so as to make the top of the trench at the surface of the ground two feet and a-half wide: this trench is filled with linings of hot dung,

on the inner edges of which, garden-lights are placed, and the lights kept covered with mats till the kale is fit to cut. The same plan," he adds, "is applicable to asparagus, and also to rhubarb, or any other perennial vegetable intended to be excited where it stands, and a covering of boards, canvas, or mats, might be substituted for the glass lights."—(*Encyc. of Gard. from Hort. Trans.* IV. 63.)

262. The foregoing method, which is particularly cleanly, and free from litter, should be compared with that practised and recommended by Barton, before named (see 257), which, however, appears to be attended with more trouble. Barton forces *on dung-beds, under frames*, exactly in the manner generally adopted for asparagus. "The advantages he considers to be the certainty of having the latter vegetable fit for use at any particular time, and the saving of dung and labour. The latter saving," he says, "must appear obvious to every practical gardener, when he considers the difficulty attending the keeping up a proper and regular degree of heat, by covering with dung over pots, and other similar methods (as generally practised) at so inclement a season of the year, requiring three times the quantity of dung to produce an equal number of heads, to what will be necessary when the roots are placed in a frame; for a common melon-frame will contain as many heads as are capable of being produced in two drills of twenty yards each, by covering with hot dung. He finds two frames, of three lights each, quite sufficient for a large family; the first prepared about the beginning of November, and the second about the last week in December; and by the time the second frame is exhausted, sea-kale will be ready for use in the open ground."—(*Idem*, 3910; from *Caled. Hort. Mem.*)

In comparing the three methods of forcing which have been detailed above, it will appear that those of Baldwin and Barton must be attended with a saving of stable-dung; but if delicacy of flavour, and, consequently, the total exclusion of *light*, be the chief object of the grower, the common method of forcing with pots, and a covering of dung, must be deemed the most efficient. The truth is this—that in sea-kale, as is the case with asparagus (see 158), a slight degree of colour is always attended by an increase of flavour; therefore, when perfect blanching (*etiolation*, as it is termed; *why*, is not apparent) and delicacy of flavour, are the chief objects, the common method is to be preferred; but when a degree of colour, and a proportionate fulness of flavour are not objected to, Baldwin's and Barton's methods are much superior to it, because, although they admit a portion of *air*, as well as *light*, they economize manure and labour. By Baldwin's plan, the roots also are preserved, whereas they are sacrificed if that of Barton be pursued; for, in forcing aspa-

ragus and sea-kale in frames, over dung hot-beds, the plants are stowed as closely as is consistent with the temporary vegetation required, and with no more intervening and surrounding soil than is absolutely necessary to supply the roots; hence, they cannot be used again, and the succession must be provided for by annual sowings; the plants being usually allowed two or three years' growth before they are taken up for forcing.

263. *Saving the Seed.*—Select one of the finest plants that exhibits the flower-stalk, and let it run up in spring; it will flower, and produce abundance of seed, which, when the silicles, or pouches, become ripe, may be gathered and preserved entire, in a dry room, for future use.

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## SUBJECT 2.

### ON THE CULTURE OF INDIAN CORN.

*December 17, 1829.*

I propose in this article to treat of the propagation and culture of this grain chiefly as a *dinner vegetable*; but as the question of the introduction of Indian corn as an article of *agricultural* produce has of late become one of very great interest, I must view it in all its bearings.

At a time when a severe conflict of opinions is maintained between some who endeavour to prove too much, and others who, through prejudice, would reject, and even vilify, a most useful vegetable, solely because it is recommended by the adverse party; at such a time, the philosophic inquirer, who, as such, is of no party, finds it his duty to bring the question to the test of experience, in order to determine whether that which is so strenuously recommended, and unwarrantably abused, be, or be not, likely to prove a public acquisition—one, in fact, worthy of being extensively, if not generally, cultivated. I record the date of this article, as well as the periods when the several operations attendant on the culture of the grain were performed, because the former may furnish matter for comparison of a variety of facts and observations; and the latter may serve as a journal or calendar of directions to the practical gardener, whose aim it shall be to collect evidence, and draw deductions.

The experiment which will be detailed was made during the late unpropitious season, a season of uncommon anomalies, wherein the most severe and parching drought in May, and during the three first weeks of June, was succeeded by vast deluges of rain, and an extremely low temperature. Between the 21st of June and the 31st of October, 1829, there were ninety days in which rain fell to a

greater or less extent; and, during that period, the thermometer twice attained  $73^{\circ}$  only, as its maximum of height. It averaged, at three o'clock o'clock, p.m., in July, about  $64\frac{1}{2}^{\circ}$ ; in August,  $63^{\circ}$ ; and in September,  $57^{\circ}$  of temperature, which scarcely, if at all, exceed the *mean* of day and night of the usual run of seasons, according to the calculations of the *British Almanac*.

264. INDIAN CORN—*Zea Mays*. Of the Class xxi. Order iii., *Monœcia Triandria* of Linnæus. Natural order, Gramineæ.

In this vegetable—which also is termed *maize*, or Turkey-corn—the male and female flowers stand apart on the same plant. The male, or staminate flowers, are produced in erect *loose* spikes, resembling panicles, at the summit of the stem. The glumes, or husks, of the male blossoms are, in some varieties, of a pale, greenish white; and in others, of a brown or purplish colour. The *calyx* is a two-flowered glume, without any awn; and the corolla is likewise awnless. The *female* flowers are produced in compound sheaths, arising from the bosom of the leaves. They consist of very dense spikes, the flowers enclosing the germens, closely arranged in upright or spiral ranks, firmly embedded in a rather conical or pyramidal receptacle, which is termed the *cob*. These cobs vary much in their dimensions; in some of the tall varieties they contain twelve ranks of seeds, each rank producing from thirty to forty grains; in others of more dwarf growth, ten ranks, of from twenty to twenty-five seeds, may be reckoned as an average product. Each seed is furnished with one pistillum, or style, very long and pendulous; the glume, or husk, of both the calyx and corolla is of two valves, and the whole spike is enclosed in an involucre of boat-shaped leaves, from eight to twelve in number. The ripe seeds vary much in colour, some being whitish, others yellow, brown, or purple. They are closely compressed in the receptacles, and hence, their sides become flattened or indented; the external surface is rounded, and highly polished. Many of the varieties of the corn, being natives of the warmest climates of America, will not ripen in this country; some of them will however grow, and attain the height of nine or ten feet. The *dwarf* variety—that which is now termed “Cobbett’s Corn,”—appears to be the only one as yet known which can be expected to attain maturity in the ordinary seasons of England. In very hot summers, however, such as those of 1818, 1825, and 1826, the variety known by the name of the “early yellow,” might, I think, be made to ripen its fruit to a certain degree of perfection. I have tried an experiment on the three following varieties, by which I have satisfied myself, that in wet seasons, the dwarf is the only one which will bring one single ear to perfection.

(1.) The *tall pale-coloured*—the seed of which is semi-transparent, and of a pale buff, or cream-colour; cobs very long, with three or four hundred seeds. It grows to the height of ten feet, produces a noble stem, and fine waving leaves, of a rich, full green tint. The ears, though they will not ripen, attain a state of mellowness, in which they form a tender and agreeable dinner-vegetable.

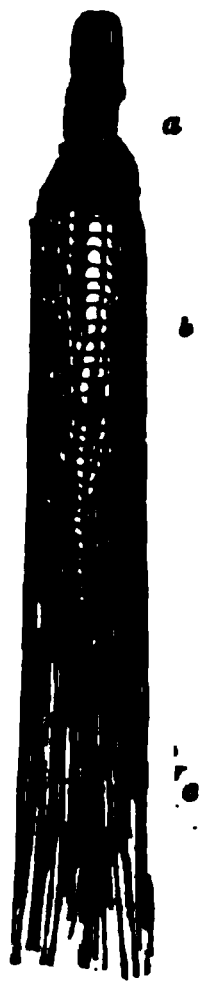
(2.) The *early yellow*—seeds of a semi-transparent, golden yellow; cobs large; do not ripen in general. It grows to the height of six or seven feet.

(3.) The *dwarf yellow*—seeds of a yellow colour, not so bright in many English-grown specimens as the former; varies in height from two to four feet. The annexed figure will convey some idea of the appearance of one of the tallest plants of this variety; it was drawn under considerable disadvantages by one of my sons, from my description, assisted by a dried specimen, and a rough sketch which I traced with a pen.

Fig. 9.



Fig. 10.



The height of the plant, fig. 9, is supposed to be four feet from the ground to the apex of the spike of flowers, *a*. The ears or cobs, *b, b, b*, are enclosed in from eight to twelve boat-shaped husks or valves, which lap over one another in opposite directions. Some of the exterior husks are furnished with arrow-shaped, terminal, leafy appendages, which wither as the seeds become ripe; *c, c*, are the sword-shaped, wavy leaves, the bases amplexicaul, deeply decurrent, *that is*, they run down the stem, and closely embrace it, till they

minate at a joint. At the point where they approach the stem, they are elegantly ciliated with silky hairs. The stem is often deeply tinged with red, or brownish purple, and the external husks of the ears, and the glumes of the male blossoms, are also purpleish. The whole plant is peculiarly interesting; the seed, the vessels of the leaves, and the system of "oscular pores\*," exhibit fine examples of the structure of one of the monocotyledonous tribe. The stem is solid, and filled with a parenchymatous pulp, containing a portion of pectharine matter.

Fig. 10 exhibits an ear divested of its external integuments. It is in a state too immature to be eaten as a vegetable, but the germs of twelve ranks of seeds (each rank containing about thirty-four seeds) are very apparent in the original specimen: *a*, shows the foot-stalk and the vestiges of the integuments, *b*, the rows of seeds, *c*, the pistilla or styles. These are of a greenish silvery white, and, when fresh, appear like semi-transparent threads of silk, or peniculous glass feathers. They are involved within the husks, but emerge (as shown in the lowest cob of the preceding figure, *b*), from the apex of the husk, about the time that the farina of the male flower is propelled from the antheræ. Examined by a powerful microscope, the styles appear like flattened bundles of reeds, abounding with spiculæ, or hair-like appendages, which proceed regularly from the surface of each reed.

265. *Uses of the Corn.*—It is eaten as a garden vegetable at the time when the grains, after being fully formed, become replete with a farinaceous milky pulp; that is, as I have found, from the close of August, to the second week of October, or even later. The ear or cob is broken off; it is then divested of its husks and filaments, the small foot-stalk is cut to about an inch in length, and the whole is boiled for half, or three quarters of an hour, in water, with a little salt. The ears are eaten with butter, salt, and pepper, according to the taste of each individual. It should be observed, that although the tall varieties will seldom ripen their seeds, the ears will notwithstanding attain sufficient maturity to be very fit for table use; but there is this material distinction between the dwarf and tall varieties, that at the time the seeds of the former become mellow, and full of milk, they are so firmly fixed into the receptacle, that they must be bitten off; whereas, the whole ear, cob and all, of the taller kinds, boils tender, and may be cut up with as much ease as the stalk of a cabbage: and it is as pleasant, in point of flavour, as the seeds. Indian corn, as a vegetable, must be very much liked, or wholly

\* See Fig. 16—2, paragraph 314.

disrelished; for its taste is too peculiar to admit of a medium; it resembles, as far as one may determine for others, that of artichoke blended with the sweet wort of malt. As an article of diet, it is said to be extremely salubrious, and nutritive in proportion as it approaches to maturity. When perfectly ripe, and ground into flour, it is said to make bread of a quality very unacceptable to most, unless it be qualified with at least two parts of wheat flour to one of the meal: in these proportions, it may be made into good and palatable bread\*. In the opinion of most who know the grain, it is considered a capital article of supply for the poultry-yard, and not for poultry only, but for pigs, and even horses. "Upon this grain," says Mr. Cobbett, "without any grinding, horses are fed, oxen are fatted, hogs are fatted, and poultry made perfectly fat, by eating the grain whole, tossed down to them in the yard. The finest turkeys in the whole world are fatted in this way without the least possible trouble."

266. *Cultivation.*—April 21.—Sowed two drills of the foreign, pale buff-coloured corn, the drills six feet apart, and two inches deep, the seeds six inches distant from each other. The soil, a cretaceous loam, manured with spit dung and coal ashes; aspect south-west, but overshadowed by a barn and tall trees.

May 6.—Sowed two drills of the dwarf English corn, purchased of Mr. Cobbett; the soil, aspect, and method of sowing, the same.

May 14.—Sowed four drills of the early *foreign* yellow, in a sandy soil, abounding with calcareous road-drift and vegetable matter; aspect commanding more sun, but sloping to the north: the plants stood too near to each other, as double drills were made scarcely fourteen inches asunder.

May 15.—Some of the young corn appeared, the rest came up in due order, but a small portion was obliged to be re-sown, in consequence of the depredation of a grub, which ate off the albumen and vitellus of the seeds.

I shall just observe, that all the varieties prospered exceedingly, till the taller sorts became injured by the storms of wind in August, which, on one or two occasions, blew them down, and rendered it necessary to tie the plants to long and strong stakes. These violent assaults retarded the growth of the foreign varieties; but the dwarf corn continued to stand erect, and sustained no injury. I shall confine my future remarks to this sort exclusively.

267. *Subsequent culture of the Dwarf Corn.*—The spaces between

\* I have tried it in the proportion of one part corn-meal to three parts wheat flour: the bread is very pleasant, with a slight, but distinct flavour of malt.

the rows were dugged once in July, pretty deeply, when the plants were half-grown; the rows were earthed up with the hoe, about three inches on each side; and again, on the 26th of July, when two or three inches of well-rotted manure were laid on each side of the stems, and over this, sand was placed ridgeways; so that the rows were supported on either side, by at least five inches of rich earth.

*August 3.*—The spikes of male blossoms were partly developed, and many of the ears began to show the pendulous filaments: the antheræ opened about this time, the farina began to fall, and thus the process of impregnation was gradually and progressively completed.

*August 10.*—Many more of the ears were formed, and many of the plants had three or four each; it is said that six are sometimes borne on one plant, but I have not witnessed the fact.

*September 4.*—First cutting as a dinner vegetable; it was tender throughout, being quite immature, the seeds were mere germs. From this period to the 12th of October, the corn was occasionally used: then, the grains became so firm, and boiled so yellow, that the few ears remaining on the stems were left to ripen.

*October 7.*—The corn suffered severely from the sharp frost, biting wind, and hail of this day, it still, however, advanced towards maturity; but the repeated frosts in the course of the month, at length decomposed the involucra of the ears, and rendered them pervious to water, which caused mouldiness. Particles of ice also, were on several occasions formed in their inner surfaces.

*November 1.*—Several ears were fine and plump, although the plants on which they grew were nearly dead. I gathered and dried them, and the seeds became firm, and remained perfectly sound.

268. *Deductions from Facts.*—The *dwarf Indian* corn will ripen even in the worst of seasons, provided the situation be open to the full sun, and the soil be favourable; but it *may* fail if it be planted in a close situation, upon cold stiff soil; and especially if early frosts supervene, before the impregnation of the germens is fully effected. Such frosts attack and decompose the slender styles, and thus, numbers of the germens retain the mere embryo form, while here and there a few ripe seeds will be produced among a multitude of wasted mouldy germs. An ear which ought to have contained 250 ripened grains, will, in such cases, produce scarcely one-third of the number. My experiment, as far as it referred to a *grain* crop, may be considered a failure, but such an one as ought to lead to further attempts; for, it was occasioned by the following causes:—I sowed too late, and in an unfavourable soil and exposure; the corn enjoyed little or

none of the mid-day and early afternoon sun, after the first week of August; the spaces between the rows, owing to a deficiency of garden-ground, were planted with broccoli; the early-formed and finest ears were gathered for table use; and finally, frosts of a destructive character intervened before the due impregnation of the later-formed ears.

Upon all these considerations, and from the fact that many of the late cobs produced grains, part of which have been made into flour, and used in bread, and part reserved for sowing, I think it just to conclude that *Indian dwarf Corn* can be ripened in all summers, and become a remunerating crop,—but that, to ensure a good result, the following rules should be attended to.

269. *Rules for a proper Cultivation of the Corn.*—Never sow in moist, cold, cloddy ground, and avoid shady and confined situations. Choose open spots, where the plants, upon an average, may enjoy twelve hours' sun, from May to the end of August; and let the soil be open, rather loose and sandy, or a light sandy loam. Sow, not later than the 21st of April, in drills three or four feet apart, and about two inches deep. Drop three seeds in spots, about ten inches or a foot asunder,—the seeds being an inch distant from each other; then draw earth over the drills, and press it firmly with the flat of the spade; when the plants rise and appear safe from the attacks of worm or grub, remove all but one of the strongest, so that they finally may stand singly, ten or twelve inches asunder in the rows. The corn will bear *transplanting*, and therefore, if care be used, other rows may be formed with the removed plants; as, however, they become dwarfed by the removal, the rows need not be more than two feet apart.

Experiments are still required in order to determine the best method of culture; but I believe the foregoing directions may be safely attended to, though they will admit of much improvement. As a *garden vegetable*, there can be no fear of a failure; and even as a grain-crop for poultry, the result will be nearly as certain; and in point of real utility, the nutritive quality cannot be doubted.

270. The foregoing remarks were written in 1829. Subsequently, I have acquired the experience of five seasons of successful culture; that is to say, during the summers of 1830 to 1835, inclusive. I have hybridized three varieties, and produced ears and cobs of far superior quality, as respects the number and bulk of the seeds contained in each. The mode of culture to secure a crop of the first quality during seasons of ordinary character, is the following.

Sow at any period between the third week of April and the middle of May, provided the ground be in a free and open condition.

neither wet nor parched, and the weather be mild. Open trenches three feet apart, as for celery, the breadth of a spade, and six inches deep. Put into them three inches of good manure, or of a compost formed by the fermentation of leaves and stable-dung, used as linings to melon or pine pits; and incorporate the manure with the soil, by digging it in, a spit deep: fill the trenches with earth made very fine, to within three inches of the previous level. When the ground has settled for a day or two, strain a line along the middle of each trench, and draw a drill, one inch deep, in which drop the seeds, three inches apart; cover with an inch of earth, and press it rather firmly on the seeds, by patting it with the flat of the spade. If the weather be dry, it will be prudent to water the trench effectually two or three times during the time the earth settles, covering the trenches with mats or boards during the heat of the day.

Most of the seeds will rise, but some underground insect frequently destroys many. The supernumeraries, when three or four inches high, will supply the deficiency, if they be carefully raised and planted directly. This replacement should be made in a warm evening, and each removed plant should be liberally watered.

When the growth of all appears to be fully established, the plants ought to be thinned out to stand one foot asunder. Every trench must, of course, be treated alike; and the future culture will consist: *first*,—in a light hoeing along the trenches to ease the soil and give freedom to the roots, which extend laterally rather than deeply, and to destroy weeds. *Second*,—when the plants become nine inches high, three inches of the soil first thrown out of the trenches should be returned, so as nearly to fill them to the old surface level. A second earthing up to the same extent will be required, when the plants shall be about eighteen inches high: this will effectually secure them from being blown over by high wind. *Third*,—when the male spikes at the summits are fully formed, it will be very beneficial to cover the spaces between the rows with an inch or two of good manure, to within three inches of the plants, and to point it in with the fork, being careful not to wound the roots or stems. This manuring will supply ample food, and cause the foliage to assume a dark, rich verdure, which it will retain during the hottest and driest season.

When the farina from the spikes shall cease to fall, the plants may safely be cut back to within two leaves of the uppermost ears; and in fine seasons, the corn will become pulpy, and fit for the table, in succession, from the middle of August, and thenceforward till it ripens. In October the plants will lose their colour, assume a pale

brown tint, and become quite ripe: they may then be drawn up, and cut off close to the soil, and hung up in a shed or barn to dry. Birds are so fond of the seeds, that it will be necessary to cover the upper part of the cobs left to ripen, with paper caps. It however ceases to be an object of economy to ripen the crop for poultry, because the grain from America can now be purchased at little more than the price of barley.

## PART II.

### OPERATIONS IN THE VEGETABLE GARDEN FOR THE MONTH OF JUNE.

271. *Sow*—Cucumbers, in the first week, if not sown last month, and thin out those which were sown, and have advanced so far as to show the rough leaf; or plant rowed cuttings. See *Appendix*.

Gourd-seeds,—that species, particularly, known by the name *vegetable marrow*:—also, sow the pumpkin.

Peas,—Prussian blue (24), Knight's marrowfats (27), earl frame, and Charlton, for late crops (27).

Beans,—the white blossom (24) for the latest crop.

Kidney-beans,—the dwarf and the runners (32), in the first week, and again in the course of the month, once or twice.

In the second and third week, carrots (76), and onions for drawing young; turnips, the white, yellow Dutch (342), and Swedish (344), for the autumnal and winter crops.

In the fourth week,—endive, for a main supply.

*Plant*—Potatoes (206), the kidneys and other late sorts, for winter crops; slips of southernwood, lavender, hyssop, sage, and other aromatic herbs. Choose a shady spot of ground, and give water occasionally.

*Transplant*—towards the end of the month, cabbage (110) broccoli (124), borecole (118), savoy (116),—chiefly into nurseries, but some to remain for early supply.

Celery (359), into manured trenches, and keep it well watered. Leeks, into an open spot of ground, six inches apart.

*Stick*—Peas; dig between the rows; draw earth to their stems; hoe between all drilled crops; destroy weeds, as fast as they appear, and remove them to the compost heaps.

*Clear off*—Cabbage-stalks, and all other kinds of litter.

*Gather*—Mint, balm, sage, and other herbs that are used in a dry state during the winter. Such plants possess their full aroma

just before they expand the flower; therefore, let that state be considered as an indication of the proper time for cutting them. Cut them in dry weather, suspend the cuttings in the open air, under a shed, and sheltered from the sun's rays.

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## SECTION III.

### PART I.

#### NATURAL HISTORY AND CULTIVATION OF FRUIT-TREES.

Subject 1. CHERRY-TREE:—*Cerasus*; (*Rosaceæ*.) Class xii.

Order i. *Icosandria Monogynia*, of Linnæus.

272. The *Cherry* is no longer of the genus *Prunus*: the flowers are white, produced in nodding umbels, and succeeded by juicy, pulpy berries. The cultivated cherry-tree, according to the *Encyclopædia of Gardening*, No. 4574, "was brought to Italy by the Roman general Lucullus, in 73 A.C., from a town in Pontus in Asia, called *Cerasus*, whence its specific name, and was introduced to Britain 120 years afterwards. Many suppose that the cherries introduced by the Romans into Britain were lost, and that they were re-introduced in the time of Henry VIII. by Richard Haines, the fruiterer of that monarch. But though we have no proof that cherries were in England at the time of the Norman conquest, or for some centuries after it, yet Warton has proved, by a quotation from Lidgate, a poet who wrote about or before 1415, that the hawkers were wont to expose cherries for sale in the same manner as is now done early in the season. The tree is now very generally cultivated, both as a wall and standard fruit, and has been forced, for upwards of two centuries.

273. *Varieties*.—"The Romans had eight kinds—red, black, tender-fleshed, hard-fleshed, small bitter-flavoured, and a dwarf sort. Tusser, in 1573, mentions cherries, red and black. Parkinson mentions thirty-four sorts; Ray, twenty-four; and Miller has eighteen sorts, to which, he says, others are continually adding, differing little from those he has described." Loudon, in his *Catalogue*, enumerates thirty-six sorts.

Forsyth recommends for a small garden:—

The May-duke, ripe in June.		
Morello	.	September and October.
Graffion	.	July and August.
Black-heart	.	July and August.
Arch-duke	.	July
Turkey-heart,		July and August.
Harrison's-heart,		Ditto.
Kensington-duke,		Ditto.

Miller considers the common red or Kentish, the Duke, and the Lukeward, as the best trees for an orchard: they are plentiful bearers.

274. *Propagation*.—Cherry-trees are multiplied by budding or grafting upon stocks of their own kind, raised from stones of the fruit which are sown in the autumn in light sandy earth, or preserved in sand till the spring following, and then sown. The young trees will come up the same year, and, in the second autumn, may be transplanted into nursery rows, at one foot distance from each other. In the succeeding summer they may be budded, if intended for dwarfs; but, if designed for standards, they should remain till they are four years old, and then be grafted or budded at six feet from the ground. The best stocks for general purposes are supposed to be raised from the wild black or red cherry, because they produce trees of longer duration than stocks do, which are raised from stones of cultivated fruit. The *Morello* is grafted upon, with a view to obtain dwarf-trees; but the *mahaleb*, or perfumed cherry, is said to furnish the best dwarfing stock. Mr. Knight observes that “the cherry sports more extensively in variety, when propagated from seeds, than any other fruit which I have hitherto subjected to experiment; and this species of fruit is therefore probably capable of acquiring a higher state of perfection than it has ever yet attained. New varieties are also much wanted; for the trees of the best old kinds are everywhere in a state of decay in the cherry-orchards; and I am quite confident that neither healthy nor productive trees will ever be obtained from grafts or buds of the old and expended varieties of this or of any other species of fruit—tree.”

275. *Soil and Situation*.—Cherry-trees prosper in a light and dry sandy loam. The May-duke should be planted against a wall, to obtain the fruit in great perfection; but it will do well as a standard, as will also most of the other kinds of cherry. The *Morello* prospers well on a wall having a north aspect; but some of the finest fruit, both for beauty and flavour, is produced in East-Kent, on very dwarf standards: in that part of the kingdom, such

trees are much cultivated. There is, in the Isle of Thanet, a peculiar cherry of the Morello kind, which is of good size, dark red, juicy, rather acrid; and this tree is never grafted nor budded: it throws up abundance of suckers, and produces excellent and useful fruit for eight or ten years, but is seldom of longer duration. I have never seen a single tree of the kind in any other part of the kingdom; but, in the "Island," it is a denizen, a naturalized subject, if not a native; forming a beautiful shrubby-tree, as well as being a considerable bearer. Cherry-trees should be planted from November to April; full standards, at the distance of from twenty-five to thirty feet apart; dwarfs, from fifteen to twenty feet; and espalier and wall-trees at about the same distance as dwarfs.

276. *Mode of Bearing, and Training.*—Cherry-trees, with the exception of the Morello, and the one alluded to above, produce their fruit mostly on studs or spurs; therefore, the bearing branches should not be shortened, unless there be a deficiency of space.

"Forsyth and Harrison train in the horizontal manner, and practise shortening the leading shoots, as in the plum, apple, &c.

"For the Morello, Harrison adopts the horizontal or half-fan method—'the horizontal method when the tree grows very vigorous, and the half-fan method when weaker.'"—(HARRISON'S *Treat. on Fruit Trees*, ch. 23.)

277. *Pruning.*—Espalier and wall-trees require a summer and a winter pruning to regulate the shoots, and to keep the trees in form and order. The directions given for pruning the apricot (165), and the plum-tree (226), will apply to the cherry-tree, and therefore need not be repeated. Standard cherry-trees require only an occasional pruning, to remove dead or decaying wood, and to regulate disorderly or misplaced branches.

278. *Pruning the Morello Cherry-Tree.*—M'Phael says (*Gard. Rem.* 133), "When planted on a wall, the Morello cherry prospers best on a north aspect; and as it produces its fruit on young shoots of the preceding year's growth, it must be managed in regard to pruning and training, in the same manner as a peach or nectarine tree, except that its bearing-shoots must not be shortened."

"In pruning Morello cherry-trees, always take care to leave every year a due supply of the last summer's shoots; and these should be left in every part of the tree, at the distance of four, five, or six inches; for this kind of cherry-tree, in particular, produces its fruit principally upon the last year's shoots."—(MAWE'S *Cal.* Nov.)

"The Morello cherry bears principally on the shoots of last year, the fruit proceeding immediately from the eyes of the shoots; and

bears but casually, and in a small degree on close spurs formed on the two-year-old wood, and scarcely ever on wood of the third year. Therefore, both in the summer and winter pruning, leave a supply of last year's shoots on all the branches, from the origin to the extremity of the tree, for the next year's bearers, cutting out past bearers to make room. It is plain that the Morello ought to have no stubs left with a view to spurs, and all forerights ought to be disbudded while young. To leave a convenient space for young wood, train the present bearers six inches apart; lay in between each of these, one young shoot for bearing next year, which will make the promiscuous distance three inches."

Underwood (*Caled. Mem.* I. 427) has often observed, "when the branches of cherry-trees are laid in too near to one another, or are crossed by branches of the same kind, or by plum-tree branches, as is sometimes the case, that although there be abundance of blossom, yet there is no crop even in good seasons. On examining the blossom produced on such crowded shoots, he found that, in fifty flowers, there were not above two styles" (251—4.): "of course no fruit could be expected. By not laying in the branches so close, and by removing all superfluous summer shoots, more light and air was admitted, and he had in consequence plentiful crops."—*Encyc. of Gard.*, 4589, 90.)

If these remarks of Underwood be founded on correct observations, do they not furnish matter for most interesting inquiry and investigation? Why should a deficiency of the female organ of the flowers be produced by a crowding of the branches? How—(the *roots* of each neighbouring tree being relatively the same)—how should crossing or interlacing of branches effect the total absence of the styles in twenty-four blossoms out of twenty-five? Were the phenomenon produced only when plum-tree branches intervened between those of the cherry-tree, it might be supposed to depend upon the superior attraction of one of the trees for the atmospheric electricity; and, consequently, upon an imperfect elaboration of the juices of the other, owing to a deficiency of electric influence; but Underwood remarks, that the crossing of branches of the *same* kind, equally prevents fruitfulness, and that the free admission of light restores it! *Light*, then, or solar vegetable electricity—supposing the observations to be correct—*restores the styles of the flower* I have no hesitation in supposing that the agency of electric current is invariably the source of fertility; but there is much mystery in the present inquiry. It is one, however, of exceeding interest, and merits the close attention and assiduous observation of the philosophic horticulturist.

279. *Protecting the Fruit, and destroying Insects.*—Mr. Cobbett says, “Cherry-trees do exceedingly well as espaliers; and as standards, though they bear prodigiously, the crop is for the birds, and not for the gardener. As espaliers, they may, as I have before observed, be most conveniently covered with a net. In the gathering, too, the espalier form is of great advantage: the fruit may be clipped off with a sharp-pointed scissors, without exposing the spurs to injury.”—(*English Gardener*, No. 264.)

Wall cherry-trees are sometimes covered, at the extremities of the young Midsummer shoots, with multitudes of a species of black Aphis. The lime and sulphur-wash named at paragraph 49, is ineffectual. Naismith recommends a fumigation, composed of pitch and orpiment (sulphuret of arsenic), in the proportion of fifteen parts of the former to one of the latter. These are to be melted together in a pipkin; and when cold, the mass is to be divided into pieces about the size of a hen's egg, and burned, by means of damp straw, under the infested trees. I tried a similar fumigation, and believe that the tree perished in consequence; soft clayey earth, beat up into a thin paste, is safer; the ends of the shoots are dipped into the mud, and the insects are thus suffocated.

Subject 2. The FIG-TREE:—*Ficus Carica*, *Urticæ*. Class xxiii.  
Order ii. *Polygamia Triœcia*, of Linnæus.

280. The *fig-tree* is a native of Asia and Barbary, but is successfully cultivated in England, sometimes even as a standard or espalier tree, but generally, when it enjoys the protection of a wall and a southern exposure. The history of the fig-tree possesses considerable interest, and its botanical character is very peculiar. The fruit is a berry filled with pulp, but not possessing the usual properties of such; it is, in fact, the general receptacle of the flowers and seeds, which it encloses, and entirely conceals from the sight. Abercrombie thus describes it:—“The flowers, male, female, and androgynous, on three distinct plants, are wholly concealed within the common receptacle, which appears first like a small round bud on the sides of the young shoots, consisting of a general cup, enclosing in a concealed order, numerous minute chaffy florets without petals, but with three bristly stamina, and two styles; and the general receptacle, or cover containing the florets, becomes the fruit, gradually augmenting in size, top, or pear-shaped, filled with a soft substance; and to the florets, succeed numerous seeds, the whole ripening soft

and tender, with a delicious rich pulp, in August and September, fit for immediate eating off the trees."

*The Library of Entertaining Knowledge*, observes, "There is something very singular in the fructification of the *Ficus Carica*. It has no visible flower; for the fruit arises immediately from the joints of the tree in the form of little buds, with a perforation at the end, but not opening or showing anything like petals, or the ordinary parts of fructification. As the fig enlarges, the flower comes to maturity in concealment: and in the eastern countries the fruit is improved by a singular operation, known by the name of *caprification*. This is performed by suspending by threads, above the cultivated figs, branches of the wild fig, which are full of a species of cynips. When the insect has become winged, it quits the wild figs, and penetrates the cultivated ones for the purpose of laying its eggs; and thus it appears both to ensure the fructification by dispensing the *pollen*, and afterwards to hasten the ripening, by puncturing the pulp, and causing the dispersion or circulation of the nutritious juices. In France, this operation is imitated by inserting straws dipped in olive oil."—(*Fruits*, 244.)

*The Encyclopædia of Gardening* says, that the fig-tree in France and Italy grows as large as our apple-trees, but in this country seldom exceeds two yards in height. The fig forms an important article of culture in the isles and borders of the Mediterranean sea, and especially in Greece, Italy, and Spain. It is also much cultivated for drying, in the south of France, and for the table, at Argenteuil, near Paris. The earliest notice we have of its culture in England, is by Turner, in 1562. The first trees were brought over from Italy, by Cardinal Pole in 1525, during the reign of Henry VIII., and yet exist in the gardens of the Archbishop at Lambeth.—(Art. *Ficus*.)

These trees are of the white Marseilles kind, and bear fruit. The treatise on *Fruits* just mentioned, observes, that "In the course of their long existence, they have attained a size far exceeding the standard fig-tree in its native situations; they cover a space of fifty feet in height, and forty in breadth. The trunk of one is twenty-eight, and the other twenty-one inches in circumference. In the severe winter of 1813-14, these venerable trees were greatly injured; and in consequence of the injury, it was found necessary to cut the principal stems down nearly to the ground, but the vegetative powers of the roots remained unimpaired, and they are shooting up with great vigour."

The history of the fig comprises a very extended period of time—by some, the tree is considered to have been known to the inhabi-

tants of the East, even before the various species of corn. Mention of it is frequently made in the Scriptures; it was highly esteemed by the Jews, and by most of the eastern nations, among which, it evidently was regarded as an important, if not a primary article of food. It is a curious fact, not perhaps generally known, that our word *sycophant*, which Johnson defines “a tale bearer, a make-bate, a malicious parasite,” and to which the French attach the idea of a calumniator, an adroit trickster (*un calomniateur, un maître fourbe*), has been derived from two Greek words, whose simple meaning conveys no idea of the modern acceptation of the compound word. (*συκοφαντης* is derived from *συκον, sukon*, a fig, and *φαινω, phainō*, I show, make appear, or manifest;) and in Athens, it was applied to persons, (“informers,”) who gave information of the clandestine exportation of figs. It is inferred from this fact, that the Athenians considered figs as a fruit of such great importance, as to cause the prohibition of their export from Attica.

281. *Varieties*.—These are numerous, particularly in the fig countries, where new sorts are often produced by impregnation of the flowers. It will be interesting to the reader to know, that among the species of the genus *Ficus*, is to be reckoned the renowned BANIAN TREE of the east, *Ficus Indica*. The fruit is insignificant, but the tree possesses the extraordinary power of sending down shoots from the horizontal, lateral branches, which take root, and thus extend all around, till one tree becomes a grove. As this tree is sacred to the Hindoos, it is styled the priests’ tree, or *Ficus religiosus*.

The fruit-bearing varieties of the fig-trees cultivated in Abercrombie’s time, as appears by the catalogue in his *Pocket Dictionary*, were :—

Early long blue or purple,	Black Ischia,	Round brown Naples,
Early white,	Green Ischia,	Long brown Naples,
Large blue,	Brown Malta,	Brown Provence
Large brown or chestnut,	Black Genoa,	Brown Madonna, or
Small brown Ischia,	Large white Genoa,	Brunswick.*

Loudon’s Catalogue contains fifteen varieties, from which six are selected; four, because of their hardiness, marked (\*), and the two others, on account of their excellence.

<p>* <i>Brown Chestnut-coloured Ischia</i> (Island of <i>Ischia</i>).—One of the largest that we have; it is of a brown or chestnut colour on the outside, and purple within; the grains are larger, and the pulp</p>	<p>sweet and high-flavoured. It ripens in August, and if planted against a hot wall, two crops may be obtained annually.</p> <p>* <i>Black Genoa Fig</i>.—This is a long fruit of a dark purple colour, the inside</p>
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being of a bright red, and the flesh very high-flavoured. It ripens in the latter end of August.

\* *Small White early Fig.*—The skin is of a pale yellow when ripe, the flesh white and sweet. It is ripe about the latter end of August, or beginning of September.

\* *Large White Genoa Fig.*—This is a large fruit, the skin is thin and yellow when ripe, and red within. It is a good fruit, and is ripe about the latter end of August. This and the preceding, bear two crops annually.

*Black Ischia Fig.*—A middle-sized fruit; the skin is almost black when ripe, and the inside of a dark red. The flesh is high-flavoured, and the trees good bearers.

*Brown and Black small Italian Figs.*—These are cultivated in *pots*, the fruit is small, round, and very delicious. Forsyth gathered from one plant in a “twenty-four” pot, two dozen of figs at one gathering.—(See *Encyc. of Gardening*, 4842.)

282. *Propagation.*—“The trees are propagated expeditiously by suckers, layers, and cuttings: suckers rising from the bottom, may be dug up in autumn or spring, with roots, and planted either in rows in the nursery, to be trained, or at once where they are to remain. Layers of the young branches and shoots, in spring, will root freely the same year, fit to plant off in autumn; and cuttings off the shoots of a year old, planted in a shady border in the spring, will be rooted, and have formed shoots above, by the end of summer. Observe, in either method, to let those for walls and espaliers be headed down within eight or ten inches of the ground, to force out lower branches as a foundation to furnish others regularly upward; but let those for standards run up with a single stem to the height intended, then branch out at the top, and form the head.—(ABERCROMBIE.)

The method of propagation by *suckers*, is easy, but the result is by no means satisfactory; trees so raised, are very apt to retain the vicious habit of throwing up an unsightly crowd of suckers from their roots.

283. *Soil.*—“The fig-tree thrives in all soils not wet at bottom; but they produce a greater quantity of fruit upon a strong loamy soil than on a dry sandy ground, a dry soil being apt to make them cast their fruit. Miller says, “I have always observed those fig-trees to bear the greatest quantity of well-flavoured fruit which were growing upon chalky land, where there has been a foot or more of gentle loamy soil on the top. They also love a free open air, for although they will shoot and thrive very well in close places, yet they seldom produce any fruit in such situations.”—(*Encyc. of Gard.*, 4852.)

284. *Situation.*—The tree is usually planted against a wall, and the situation is preferable in our cold and uncertain climate, because of the facility with which wall-trees can be protected by means of

woollen nets. If the wall be flued, or built hollow, a slight degree of artificial heat may be given, in order to hasten the maturing of the fruit. The distance at which the trees should be planted, must depend upon the height of the wall; the preference is given to low walls, because the habits of the tree adapt it to being trained low; and when so trained, it not only can be more readily protected, but is more benefited by reflection from the heated surface of the soil. For *low walls* and *espalier rails*, on which the early hardier figs will succeed, the distance from tree to tree may be eighteen or twenty feet.

285. As a *dwarf standard* some kinds will prosper and bear well in the south of England, as is proved by the fact that there are orchards of figs, one of nearly 100 trees, near Worthing, in Sussex. "At Argenteuil, (in the north of France,) where the fig is cultivated in immense quantities for the supply of the table, the plants grow as dwarf standards; and the chief part of their culture, Bosc observes, consists in keeping their branches, short, low, and spreading, to enjoy both the heat of the sun, and reflection of the earth. The ground is manured occasionally, and stirred once a year; and for protection from the frost during the winter, the circumferential low branches are buried six inches in the soil, and the central ones enveloped in litter."

286. *Pruning*.—It has been a common observation that fig-trees must not be pruned, as *a pruned tree never bears fruit*,—they therefore, in the long run, become straggling, unsightly objects. Even the great Miller has remarked, that most gardeners imagine that fig-trees should never have much pruning; or, at least, they should always be suffered to grow very rude from the wall to some distance. Such ungain trees may be in the recollection of many readers; and they still, no doubt, are to be found,—but recent experiments, and the close observations of the philosophic president of the Horticultural Society, and of other physiological gardeners, have pretty nearly established the fact, that the fig-tree may be pruned,—and being kept in regular form and order, *may* be rendered proportionably prolific. The following interesting observations will tend to reveal the cause of the former prejudice, and the philosophy of the new mode of training.

287. *Mode of Bearing*.—The Hon. W. Wickham has observed, that "the fig-tree is distinguished from most, if not from all other trees, by this extraordinary property, that it bears,—and in warmer climates, brings to maturity,—in every year, *two* successive, and distinct crops of fruit, each crop being produced on a *distinct set of shoots*. The shoots, formed by the first or spring sap," (that is to

say, the shoots made in the current spring,) “put forth figs at every eye as soon as the sap begins to flow again in July and August. These figs (which form the second crop of the year), ripen in their native climate in the course of the autumn; but rarely, if ever, come to perfection in England, where, though they cover the branches in great abundance at the end of the season, they perish, and fall off with the first severe frosts of the winter. The shoots formed by the *second flow* of the sap, commonly called the *midsummer shoots*, put forth figs in like manner, at every eye, but not until the first flow of the sap in the following spring. These last-mentioned figs, which form the first crop of each year, ripen in warmer climates during the months of June and July, but not in this country before September or October. In warmer climates, indeed, very little attention is given to this first crop, because the midsummer shoots, on which it is borne, are commonly in the proportion only of one, to six or eight in length, when compared with the shoots of the spring, which produce the second crop; and the crop itself is always small, in the same proportion. But in England it is the reverse, as no care or skill of the gardener can ever ensure a second crop of ripe figs in the open air.”

I have marked in italics those words of the above passage which indicate the peculiar constitutional, or local, habits of the tree; and the reader will perceive that, in England, the *year old wood is to be relied on for the crop in the open air*,—whereas, in warm climates, the shoots of the current spring produce the staple supply for consumption and export. The first crop from the former wood is called the “boccôre,”—the second, from the young wood, is called “karmouse,” or “summer figs.” This is the crop which is dried.—“When the karmouse ripens in Syria or Barbary, there appears a third, which often hangs, and ripens upon the tree after the leaves are shed.”—(*Treatise on Fruits.*)

The *Horticultural Transactions* record a fact, which London quotes at No. 3162 of his *Encyclopædia*, by which it appears that Mr. Knight produced from the large white fig, by a peculiar treatment in his stove, *four crops* in one year,—and again, four crops more, from the same tree, in the succeeding year, “being eight crops within twelve months; and upon a ringed branch of one year old, and about an inch in diameter, a *ninth* crop, consisting of sixty figs, will ripen within the next month!”

288. *In pruning*—and with a view to procure abundance of midsummer shoots, which, in this climate alone, are to be depended upon, Mr. Wickham breaks off the spring shoots about the period that the flow of the spring sap abates, taking care to leave, unbroken,

enough of each shoot to admit of its being nailed close to the wall at the next winter pruning, and to secure one eye, at the least, uninjured by the fracture. The shoots are to be broken, but not cut,—and the operation causes the protrusion of two or three midsummer shoots, by which the supply of bearing wood is greatly increased. “Keeping this object in view,” he adds, “the knife cannot well be used too freely in cutting away the old wood.”

289. Knight disapproves highly of training the branches of fig-trees perpendicularly, as encouraging too much the prolongation of the shoots: he approves of the above method in warm situations, but in high and cold ones, he radiates his branches from the top, and the parts near it, of a single stem;—he says, “Let the stems, if there be, as usual, many within a narrow space, be gradually reduced to one only; and from the top, and parts near it, of this, let lateral branches be trained horizontally and pendently, in close contact with the wall. Under such treatment all troublesome luxuriance of growth will soon disappear; the pendent shoots will not annually extend more than a few inches, and few, or no more leaves will be produced than those the buds contain before they unfold. The young wood consequently ceases to elongate, very early in the season, and thence acquires perfect maturity; and by being trained close to the wall, is placed secure, or nearly so, from injury by the severest frost. The quantity of mature and productive young wood, thus necessarily becomes very great, relatively to the size of the tree; and the fruit being in contact with the wall, and not shaded by excess of foliage, acquires an early and perfect maturity.”—(*Hort. Trans.*, Vol. III., 307.)

290. *To produce fertility in the last year's Midsummer Shoots.*—The Rev. G. Swayne has adopted a method of de-fructification, which he considers specific. It consists in rubbing off, as soon as they can be seen, “all the figs which are produced after midsummer on the same year's shoots.” The object is to prevent exhaustion, and to promote the preparation of new embryo figs for the succeeding year. “If the operation be performed in due time, it will not fail to prepare on one, and often on both sides of almost every fig so displaced, such embryos. For this purpose, the trees should be examined once a week, from the beginning of August, at which time the figs of this second crop make their appearance.” I entirely concur with the author of the *Encyclopædia of Gardening* in his remarks (No. 4860), that the above practice, in connexion with Mr. Knight's mode of training, must effect important improvement in the culture of the tree. In fact, whatever tends to prevent mere luxuriance of growth, —to determine the flow of the two currents into that wood which is the sole bearing-wood in our climate, and thereby to strengthen and

mature it,—must promote its fertility in the ensuing season. Much of the energy of the tree would naturally be exerted in the enlargement of those autumn figs, which, after all, must be considered a source of exhaustion, since they never ripen; and therefore to remove them, is only to disburden the tree of what Mr. Swayn justly terms “sterilizing incumbrances.”—Again, by training the tree with one single stem, and the branches from it, in a radiating star-like order, much of the raggedness and deformity resulting from the old method of training will be avoided.

291. *Protection during Winter.*—This is considered indispensably necessary by most gardeners, and many modes of defending the trees have been recommended: they are mentioned in the *Encyclopædia of Gardening*, No. 4861. Mr. Wickham observes, “that the covering, where used, should be as thin and light as the circumstances of situation, aspect, local shelter, and varying temperature will admit, and that it should generally be removed in the day time and always on the return of moderate weather.”

292. *Woollen Nets*, if rough, and very strong in texture, would, I believe, afford a very adequate protection. The tree being trained close to the wall, let one net be suspended from the coping in front of the whole tree, and not above eight inches from the branches. Exterior of this, and in a sloping direction, at an angle of about twenty degrees, suspend another woollen net, from the coping to the soil of the border; and secure both to smooth poles fixed firmly to the ground, and placed against the coping in a direction corresponding with that of the nets, so as to support them effectually, and prevent their being blown away by the wind. By adopting this mode of protection, the free admission of sun and air is provided and the electrical surfaces are changed,—so that the evil effects of frosts and dews are warded off;—this having been treated of at length in the article on HEAT, I shall only observe, that my electrical theory corresponds with the practical remarks of Harrison, to whom I am indebted for the knowledge of woollen nets, though not to the particular application of them;—he says, “This netting comprehensively preserves the bloom,” (of peaches, &c.) “as the *frieze* which it receives the *hoar frost*, and as it dissolves in the morning, a large portion of light and air is afforded to the trees; it also resists the force of winds, and is an effectual protection.”

293. *Conclusive general remarks.*—To evince the facility with which the fig-tree may be propagated and fruited, I add the following interesting observations:—“Monck believes the fig to be, of all other fruit-trees which we cultivate in our gardens, the most understood; but to those who have acquired a knowledge

habits, the most tractable. 'No tree is propagated more easily. I sent from London, in April last, to Kelsay, in Northumberland, two cuttings of figs. They were so small as to travel by the post, in a common letter cover. I have gathered this autumn, from one of them, three ripe figs, and two from the other. The fig-tree may be checked in its useless habit of luxuriant growth by ringing, so as to become fruitful at a very small size. It may be forced by heat and liquid manure, with copious irrigation, so as to support an abundant crop of fruit, and bring them to perfection to a greater extent than any other tree. *Spare branches* of a large fig-tree may be *ringed*, and surrounded by a small pot of earth, into which they will readily strike root, so as to bear being separated in autumn from the tree; and they may be used to furnish any glass-houses with trees to bear fruit through the next summer. I believe, too, that the fig-tree may be easily propagated by inoculation, if that should be desired.'—(*Hort. Trans.*, 5, 173.)

“Monck tried ringing,” (*in order to ripen the fruit*), “and found that it may be practised on the fig-tree with as much safety, and more effect upon the age of its fruit, than on the pear-tree.”—(*Encyc. of Gard.*, Nos. 4840, 4865.)

The culture of the fig against a good south or south-east wall, is very simple. The soil should be a free strong loam, resting, if possible, over chalk. In that case it will be, naturally, well drained; but if no chalk be present, good drainage is essential, and with *that*, a copious supply of water will never do any injury. *Pruning* of the bearing branches is not required; and if they become too numerous, the supernumeraries should be cut entirely away. The branches may be trained close in, or be suffered to project and hang loose in their natural figure.

Fig-trees will bear frost of moderate degree; but the January of 1838 killed numbers to the ground. Boughs of spruce fir interlaced with, and made to cover, the branches, form a capital screen.

#### FORCING THE FIG.

Figs *bear forcing* very well, provided the heat do not much exceed that of the cherry-house; but few varieties will bear the heat of the stove or warm vinery. In pots capable of containing a peck of mould, small fig-trees of *Lee's perpetual*, do perfectly well, in a temperate vinery, where the fire-heat seldom exceeds sixty or sixty-five degrees. Two or three dozens of fruit may be seen on a bushy tree little more than two feet high, with a succession crop arising from the axils of the leaves. If the growth tend to luxuriance, the

point of each shoot, just at a part between the two upper joints, should be pressed by the thumb and first finger, till the substance be found to yield. A check will thus be given, and fruitful laterals produced.

The soil for pots may be composed of turfy loam, three-fourth parts, the remaining fourth consisting of lime rubbish and bruised bones, in equal quantities; each pot should be drained with an inch stratum of broken garden pots or fragments of tiles. The soil should be renewed after the period of a winter's repose, and prior to the next year's excitement. It will generally be sufficient to pare away about an inch of the old ball, with the roots therewith contained; and after returning the plant, to insinuate fresh earth round the sides and among the roots with a pointed stick.

## PART II.

### OPERATIONS IN THE FRUIT DEPARTMENT.

294. *Attend* to the summer pruning and regulation of the fruit-trees; train in the well-placed shoots of wall and espalier trees.

*Stop* the shoots of vines, by nipping or cutting off the young fruit-spurs, within two or three eyes above the fruit.

*Tie up* the young advancing shoots of fresh-grafted trees; water newly-planted trees, if the weather be dry.

After pruning, or any other operation which shall have rendered the borders unsightly, remove litter, dig the soil lightly, and rake, or pass the Dutch hoe lightly over the surface.

### MISCELLANEOUS.

295. *Sow*—in the flower-borders, a few annuals for succession.

*Plant*—layers and pipings of pinks, clove-pinks, carnations, &c.

*Transplant*—into beds and borders, many of the tender annuals—balsams, cocks'-combs, tricolors, globe-amaranthus, and the like—and introduce several of the beautiful Orchis tribe, of which the fragrant night-smelling butterfly, *Orchis bifolia*; the spotted, dwarf brown-tipped, and aromatic, are now in flower.

If heath-mould, (called *peat*,) be at hand, bed out into it, *azalea indica*, *ledifolia*, &c.; *Acacia armata*, and some other hard-wooded green-house plants: to be re-potted in autumn.

*Geraniums*, set in the open ground, produce a beautiful effect. Some of the species (particularly the horse-shoe, *Pelargonium zonale*) grow luxuriantly, and are readily propagated by cuttings, which, in all likelihood, will flower in the autumn.

*Tie up*—tall flowering, annual or herbaceous plants; dig up, dry, and secure bulbous roots, whose leaves have decayed; keep the borders neat, and free from litter, constantly removing decayed leaves, and stalks of flowers which have done flowering.

*Select Shrubs and Plants that flower in the month of June.*

296. *Deciduous Shrubs*.—Roses of many sorts, *Rosa provincialis et sinensis*; *Azalea*, six or eight species; *Spiraea*, three or four species; guelder rose, *Viburnum opulus*; alspice-tree, *Calycanthus floridus*; shrubby floriferous cinquefoil, *Potentilla floribunda*; fringe-tree, *Chionanthus virginicus*. All the scarlet Pelargonium.

*Evergreen Shrubs*.—Rock-rose, *Cistus*, ten or twelve species; rose-bay, *Rhododendron*, as many; whortleberry, *Vaccinium*, six species; heath, *Erica*, three species.

*Herbaceous Plants*.—Indian pink, *Dianthus, sinensis*, and *latifolius*; larkspur, *Delphinium Ajacis*; monkey-flower, *Mimulus luteus*; mignonette, *Reseda odorata*; marvel of Peru, *Mirabilis jalapa*; rose campion, *Agrostemma coronaria*.

*Bulbous Roots*.—Atamasco lily, *Amaryllis atamasco*; yellow dog's tooth, *Erythronium dens-canis, lut.*; ranunculus, anemone, many varieties; Orchises, the dwarf, aromatic, spotted, military, broad-leaved, and probably the bee, *Orchis ustulata, conopsea, maculata, militaris, latifolia*, and *ophrys apifera*.

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# THE NATURALISTS' CALENDAR.

JUNE.

THIS month, if the weather be propitious, is one of the most joyous and beautiful months of the year. Sometimes, however, the weather is subject to considerable mutations: now and then, a cold, parching east wind prevails, and, excepting the greater length of the days, converts the month into a second March. Generally, the weather is agreeable, and the average temperature moderate. The air is perfumed with the fragrance of the new-mown hay, and the flowers of the field vie in beauty with those of the garden. The woodbine and bean blossom are pre-eminent among the sweet-smelling flowers of the month: and after sunset, the pale blossoms of the butterfly orchis, yield a perfume not inferior to that of the honeysuckle; with the peculiar odour of which they unite, in some degree, that of the Cape-jasmin. (*Gardenia*.)

The average height of the Barometer is about 30 Inches.  
Ditto of the Thermometer, about 60 or 61 Deg.

*In the first week.*—The grasshopper (*Gryllus grossus*), the rose-chaffer (*Scarabæus auratus*), and wasps (*Vespa vulgaris*), appear; small dragon-fly (*Libellula virgo*), argus butterfly (*Papilio moera*), and other flies and butterflies, appear.

*Second week.*—The Burnet hawk-moth (*Spinx filipendulæ*), appears; missel-thrush, or storm-cock (*Turdus vicivorus*), and yellow-hammer (*Emberiza flava*), sing.

*Third week.*—Stag-beetle (*Lucanus cervus*), butterflies (*Papilio*) and moths (*Phalæna*), abound; the quail (*Perdix coturnix*), utter its peculiar call in the grass, which, like that of the corn-cra ( *Rallus crex* ), is so deceptive to the ear, that it is almost impossible to determine the spot from whence it proceeds.

*Fourth week.*—The nightingale, redstart, and cuckoo, usually become silent; but the black-cap (*Motacilla atricapilla*), w throat (*Motacilla sylvia*), grasshopper-lark (*Alauda trivialis locustæ*), and willow-wren (*Motacilla curucca*, or *salicaria*), continue in song.

J U L Y.

## SECTION I.

## SCIENCE OF GARDENING.

## VEGETABLE PHYSIOLOGY.

## PART II.

## INTERNAL STRUCTURE, OR VASCULAR SYSTEM OF PLANTS.

297. UNDER this head are comprised all those vessels and organs which convey and distribute the vegetable vital fluids. These are partially discoverable by the naked eye; for when a stem or stalk is divided longitudinally or transversely, it will appear to be composed of fibrous and pulpy masses, so arranged as to afford evident proofs of being destined to specific offices. The unassisted sight, however, will not be able to discern the minutiae of the structure; nor can it determine the precise form, or arrangement of the masses; it therefore becomes requisite to have recourse to instruments of dissection, and to high magnifying powers. In order to simplify as much as possible a pursuit which is sufficiently perplexed with difficulty, our first inquiries must be directed to ascertain what instruments are required for the complete dissection and investigation of subjects so minute and delicate as those of the vegetable structure.

298. The *instruments of dissection* indispensably required appear to be two very fine pointed lancets; one or two penknives, with thin blades, sharp edges and points; two long and stout needles, the eyes of which are either covered with a knob of sealing-wax, or let into a small smooth handle; and two pairs of sharp-pointed steel tweezers, made of the main spring of a watch, or some such material.

299. The *instruments of observation* are two eye glasses, or spectacles, of different powers, to be used in dissecting the subject in the first instance; a powerful microscope, one or more watch glasses, and as many of those flat, and slightly-concave glasses, to fit into rings or grooves, which are usually attached to the microscope, and form part of its apparatus.

It fortunately happens that scientific researches can now be undertaken with comparative facility; the young gardener, therefore, who is desirous of acquiring the "science" of his art, can effect his object readily and cheaply. On the subject of vegetable physiology in particular, connected with the anatomy of plants, the *Treatise in The Library of Useful Knowledge*, 'On Vegetable Physiology,' published originally, and the New Botanical Series, (of which four numbers appeared in 1835,) are, with few exceptions, choice compendia, which, for their size, contain more comprehensive information than any other works that I have met with. I shall have occasion to allude frequently to these treatises, and earnestly recommend them to the curious reader who is in search of physiological information.

300. *On the subject of Vegetable Anatomy.*—The *Treatise on Vegetable Physiology*, page 2, observes, "To enable us to examine the intimate structure of plants with advantage, the aid of a powerful microscope is requisite; and the objects to be examined should be placed in a drop of clear distilled water. If we wish to examine the component parts of the plant, the portion containing them should be plunged in nitric acid, and the phial placed in boiling water, which must be kept at the boiling point for twelve or fifteen minutes. By this treatment, the parts composing the vegetable tissue lose their cohesion, and become transparent, which greatly facilitates the investigation of them: the boiling, however, must not be carried so far as to disorganize the tissue; but whenever the transparency is produced, and the parts separate of themselves, the boiling should be stopped, and the parts disjoined with pincers, under distilled or filtered rain water."

In the foregoing passage, we have to lament the absence of clear and definite instructions; and I quote it in order to induce the the author of the *Treatise*, or some one who is concerned in the management of *The Library of Useful Knowledge*, to furnish the minute particulars of a process which is described in terms far too vague and general. There are doubtless many readers who have found themselves in the same predicament with the lady who addressed the following letter to the editor of a recent periodical which work she herself has enriched with several perspicuous articles on the Linnæan system of Botany.

"I take a great interest in the physiology of botany, and have often lamented the insufficiency of microscopes to enable me to ascertain the organization of plants. From a number of *The Library of Useful Knowledge*, I learn that this inquiry is facilitated by plunging the parts to be examined in a phial of nitric acid, placing

the phial in boiling water, and keeping it at the boiling point for twelve or fifteen minutes. I have tried this, but cannot succeed; the contents of the phial, when taken out, were merely the acid and a portion of pulp totally disorganized, and in a state of effervescence that would admit of no examination, had there been anything to examine. I tried it with half the boiling, but even then the parts were one confused mass, from which nothing could be understood. Can you give me any information about this; or if not, will you put a query to that effect in the magazine?"—(See *Mag. Nat. Hist.*, No. 5, page 495.

I may add, that the letter describes the exact results of the experiment when it is so conducted; but admitting that the whole of the vegetable texture is not destroyed—that some tangible atom may remain, it will be so saturated with acid, that the instruments of dissection—the sharpest and most pointed lancets, needles, or knives—will be so blackened and corroded, as to become in a few minutes entirely useless. The directions, also, say nothing concerning the strength or specific gravity of the acid, nor whether it is to be used *pure*, or diluted with a given quantity of water; on these material points we are left to determine for ourselves, and, accordingly, I tried acid of various degrees of strength, and, for a time, every trial was a failure. In fact, it could not well be otherwise; for nitric acid is one of the most highly oxygenized substances we possess, and it parts from its oxygen with great facility; hence, it exerts a most active agency on many decomposable bodies; and as steel is one of those substances which it seizes on with peculiar activity, it cannot fail to destroy, or greatly injure, those instruments with which it comes in contact. In the *New Treatises*, we have more explicit directions, which I shall allude to.

301. In *dissecting vegetable bodies*, a steady hand, a keen and discerning eye, and a certain degree of intuitive or acquired adroitness are indispensably required: but with these, plants in general may be anatomized without the assistance of acid agents. A single microscope,—that is, one with a single lens of high power,—ought to be employed for the investigation of very minute objects: such glasses transmit more light than the more compound instruments, and, therefore, a few lenses of different powers, from 100 to 260 times, should always be kept in readiness. Nevertheless, the compound microscope, possessing much higher magnifying power, may at times be employed to great advantage, particularly when the object is transparent, and a very brilliant sun light can be passed through, and upon it.

302. *Nitrous acid* may sometimes be required in order to reduce

[JULY.

very refractory subjects, and to procure transparency; and I find the mode of using it, now to be described, available in most instances: at least, the process is under the control of the operator. Let one part of the fuming nitrous acid of the shops—that of a brownish orange-colour—be diluted with twice its bulk of pure, or filter rain-water. Put about half a tea-spoonful of this weak acid into a watch-glass, and with it, the object to be examined. If that very delicate, it will suffice to let the glass float on the surface of boiling-hot water in a cup, for a few minutes; but if it be so and opaque, it will be needful to support the glass on a fixed rim on the open stage of the microscope, and then to expose it to the heat of a small spirit-lamp, or wax-taper, cautiously applied under short of boiling; and as it evaporates, and becomes more concentrated, a few drops of hot water may be added to keep up the quantity of fluid. The approach to transparency will determine the duration of the process; but the moment that it becomes the heat is to be withdrawn, and the acid poured off. It is next to be washed two or three times with a little water, and, finally, the remaining acid is to be neutralized, by a part of fluid ammonia (*liquor ammoniæ fortis*). This, with needles or tweezers, may now be effected without injury to the instrument, which the slightest exposure would produce. A few carefully conducted experiments to the necessary dexterity: and that being once acquired, nations will be carried on with pleasure to the operator.

303. Although I admit that the agency of plants occasionally be required to subdue the more refractory plants, yet experience assures me, that dissections will generally succeed better without any chemicals. But whether acid be employed or not, the parts rendered somewhat more transparent by being put into a minute drop of filtrated, or very pure water, it should be remembered that water it is of fluid; that a ray of light from a mirror or of sun-light,—must be thrown direct upon the object of water, and that the sun's rays are the electro-chemical divellent attractions.

Will not the philosophic mind detect in many optical deceptions! May not the hazy molecules," lately advocated, be resolved into effects by the play of affinities between

the component or elementary parts of vegetable and mineral substances, placed in that fluid, within the immediate influence of solar light? The molecules are discernible only when the matters to be examined are placed in water\*; they are not even then discernible at all times; and, as far as my testimony may go, they are not to be discerned at all; for after repeated, and very protracted investigations with a variety of powers, I have never been able to discover in the farina of flowers, any other phenomena than an occasional change of form: hence—and on the ground of the discovery of the agency of membrane, by Dutrochet—I am inclined to suggest, that the appearance of what are termed molecules, is invariably occasioned by electric agency, producing decompositions and attractions, consequently, some motion among the particles attracted.

304. *Elementary Components of the Vegetable Organs.*—By the term elementary is to be understood the first principles of matter, those which cannot be further reduced by analysis or decomposition, nor traced beyond a certain point. By the term *vegetable elements*, phytologists designate those parts, fluid or solid, which are the primitive components of the whole structure; thus the *sap* may be considered as the most simple of the vegetable fluids, and so far an element, as from it are derived all the solid components of the vegetable,—such at least is, or was, the popular opinion. But the electrical theory presumes that the true elements of vegetable matter are to be traced to those of water, which it regards as the ultimate origin of all decomposable things.

The primitive *solid* components are, according to the *Treatise*, *membrane* and *fibre*, from which the whole structure of the solid parts of the vegetable are ultimately formed.

305. “*Vegetable membrane* is an exquisitely thin, transparent, colourless film, which resists the action of water, and watery solutions in the living plant; but when life ceases, is quickly acted upon by water, and reduced to mucilage. Du Hamel has asserted that vegetable membrane is composed of small organic fibres, arranged parallel to one another, and united by a glutinous substance; but no such structure can be detected by the microscope,—on the contrary, it resembles a simple pellicle, or the film of a soap bubble, varying in transparency in different parts of the plant. In the simplest state, it forms the sides of the cells of the cellular tissue: a little more condensed, the general covering, epidermis, or outer skin. It has also been supposed to derive its origin from minute globular bodies found in the elaborated sap, which are dilated into vesicles to constitute the cellular tissue.”—(*Treat. on Veg. Phys.*, page 1.)

\* See LONDON'S *Magazine of Natural History*, March, 1829, vol. ii. page 46.

306. The most comprehensive and philosophical view of the elementary components of the vegetable structure, appears to me that of Keith, the author of *The System of Physiological Experiments*. "If," he observes, "the embryo, on its escape from the seed, is taken and minutely inspected, it is found to consist of a root, plumule, and incipient stem, which have been developed in consecutive order; and if the plant is taken and dissected at this period of its growth, it will be found to be composed merely of an epidermis, enveloping a soft and pulpy substance which forms the mass of the individual; or it may be furnished also with a central and longitudinal fibre; or with bundles of longitudinal fibres, giving tenacity to the whole." These parts have been developed, no doubt, by means of the agency of the vital principle operating on the proper juice; but what have been the several steps of the operation? The author adduces the hypothesis of some philosophers who have endeavoured to account for the phenomena by assuming a process which admit of no proof: he then adds, that M. Mirbel, in the course of all plausible conjecture, submits the following:—"He supposes the proper juice to be at first converted into a fine membrane, from which he calls the membranous tissue, from which the cellular tissue and the pulp is afterwards formed by means of the foldings and doubling of the original membrane, so as to present an hexagonal appearance similar to that of the cells of a bee. The tubular tissue he supposes to be in like manner formed out of the cellular tissue, by means of such openings and perforations as may be accidentally effected in the tissue itself from the bursting of the vertical partitions of the tubes, the tubes having no existence till the membrane is lacerated (*Traité d'Anat. et de Phys. Veg.* liv. i.) "But if the tubular tissue is generated in the manner here supposed, that is, by the accidental bursting of the partitions of the cells, it will be difficult to account for the known regularity with which they are formed. The circumstance giving plausibility to the conjecture is that occasional occurrence of a transverse membrane, interrupting the continuity of the small tubes, which M. Mirbel regards as a proof of their cellular origin."

"It is much more likely, however, that *the rudiments of the different parts of the plant do already exist in the embryo*, in a specific order of arrangement as shall best fit them for future development, by the intro-susception of new and additional parts, rather than that the vital principle should first manufacture a membrane which it then converts into *cells*, which are afterwards partially and accidentally converted into *tubes*, and the plant so patched up. if this were the fact, there would be no such thing as saying,

species of plant any particular seed might produce when committed to the soil."—(Vol. ii. 201—3.)

This conjecture, that all the rudiments do exist in the embryo, or, in other words, that the plant from its first developement is perfect in all its organs, and that its future progress is that of growth and enlargement of parts already formed, not the creation of new ones, is so rational, so conformable to the analogy of nature, that I think it needless to adduce further arguments in proof of what can scarcely admit of a reasonable doubt. I shall therefore pass on to the inquiry into the structure of the vegetable vessels.

.307. *Vascular System of Plants*.—This comprises a system of vessels and tubes, and a congeries of membranous cells; the former includes, first, those conduits or vesicles by which the ascending sap is conveyed from the root to the extremities of the leaves; second, those reducent vessels by which the sap is conducted downwards to the root. Both will be particularly noticed in due order. The membranous cells, or utricles, are those fine vessels which constitute the cellular tissue; they appear to be the depositories of the juices of the plant, which, to a greater or less extent, have undergone the process of elaboration. M. de Mirbel, who may be accounted the most celebrated of the more modern French phytologists, has distinguished five species of tubes, whose office it is to conduct, or to aid in the conduction of the fluids ascending from the root; and one other set appropriated to the return of the laborated fluids. They are thus described:—

(a.) *Porous tubes* are continuous vessels, pierced with small holes or pores, which are often distributed in regular and parallel rows. They are found most abundant in woody plants, and particularly in wood that is firm and compact, like that of the oak; the porous tube appears to be identical with the *punctuated* vessel described at No. 311, (2.)

(b.) *Spiral tubes* are fine, transparent, and thread-like substances, twisted from right to left, or *vice versa*, in the form of a cork-screw. They are abundant in herbaceous plants, particularly in aquatics. These tubes were originally termed *tracheæ*—windpipes—being considered as conductors of air only. (The term *trachea* is derived from *τραχέα*, rough, rigid: such being the texture of the windpipe; the *aspera arteria* of the old physiologists.)

(c.) *False spiral tubes*. These are apparently spiral on a slight inspection, but if minutely examined, are found not to be spiral, but cut transversely by parallel fissures; they appear to correspond with the *annular* and *reticulated* vessels hereafter to be described. See 311, (1.)

(d.) *Mixed tubes* combine in one and the same vessel two or more of the foregoing varieties. Mirbel adduces the *butomas umbellatus*—flowering rush—as an example, wherein the porous, spiral, and false spiral tubes, are to be met with united into one. This species of tube will be more minutely described with the punctuated vessel.—See 311, (2.)

(e.) *Small tubes* are composed of a succession of *elongated cells*, the perforation of which is, in appearance, interrupted by a few small transverse portions of membrane crossing the tubes, like valves, as exemplified in the structure of the cellular tissue; with this difference, that these small tubes are considered as the conduits of the sap, and not the depositories of elaborated juices. Such are the ascending vessels of the plant, they are either direct conductors, or accessaries to the conducting tubes.

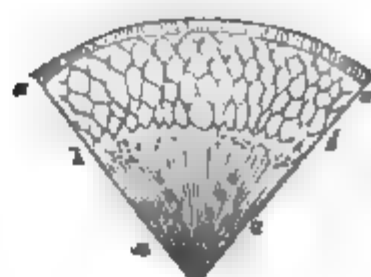
(f.) *The simple tubes*, the only species that remain to be noticed, appear to be appropriated chiefly to the conduction of the laborated, or returning fluids. They are composed of thin and entire membrane, pervious throughout, without any interruption of continuity, and are principally to be found in the bark. These tubes correspond with the *reducent* vessels described at 317.

308. *Vessels of the Root and Stem, (Caudex.)*—If a very thin slice of an herbaceous plant, or of a young annual stem, be placed under a magnifying glass, it will appear to be composed of a mass of cells and tubes. If the section have been adroitly made, these vessels will be seen arranged with much order and symmetry; but the mode of arrangement will be found to vary exceedingly in different subjects: thus, if the stem of a *fungus* or *mushroom* be examined, the internal structure will appear to consist almost entirely of cells, arranged parallel to each other, and enclosed in an epidermis, or external skin. If an *herbaceous* plant be investigated, it will exhibit a cuticle and bark, surrounding an assemblage of two or more sets of vascular organs, of a character very different the one from the other. One set is of a soft, spongy, and juicy texture; the other is more compact, combined into masses or knots, and less transparent. If a thin cutting of the same subject, in a vertical, or upright direction, be now examined, it will appear that the transparent vessels consist of cells or short cylinders with separating membranes, crossing, and closing them at short distances, one above the other, and somewhat resembling elongated cells of a honey-comb. The vessels of the other set appear to be long continuous tubes, perforated and hollow throughout. “In the greater number of plants, the form of the cells in the bark, and in the pith is nearly the same. In annual and herbaceous plants, the cells are almost all uniform in

figure, when viewed in a transverse section of the stem; but in a vertical section, those of the exterior part of the bark, and those surrounding the vessels, are longer, and of a more tubular character than the others, and resemble, in some respect, short, pointed, close tubes, united obliquely at their points."—(*Treatise*, 3.)

The situations of the cells and vessels are represented in the annexed figure, where *a* shows the bark and cuticle; *b b*, the soft, spongy mass, termed the *parenchyma*, or cellular tissue; and *c c*, the less transparent masses or knots, which consist of clusters, or detached sets of conducting sap vessels, which in the case of *purely herbaceous stems*, are accompanied with returning vessels, that form a part of each bundle.

Fig. 11.



309. *The Cellular Tissue*.—This substance, which is also termed *parenchyma* (from *παρεγχυμα*, *paregchuma*; a spongy, or porous body, or pulp), is that soft juicy mass, figured at *b*, which forms the bulk of some plants, and a considerable part of most of the herbaceous, and of many shrubby plants. It is found in the substance of the stem under the bark, in the bark itself, and in the body of the leaves; in which it is the source of colour, being that green pulp which fills up the space between the two cuticles of the upper and lower surfaces; and consequently, forming the bulk of the leaf. It consists of cells, filled with fluid, usually of a green tint. These cells vary much in appearance and structure; in some plants they are of a globular figure, in others, their form is that of a six-sided, or twelve-sided cylinder, transversely divided. "The size of the cells varies in different plants, and in different parts of the same plant. In general they are smallest in the leaves, larger in the roots, and largest in the stems of the same plant; and larger in annual and succulent plants than in trees and shrubs. In ligneous (woody) plants, the cells of the pith are larger than those of the parenchyma, and are visible to the naked eye; but in some parts of the plants they are so minute as to require a million to cover a square inch of surface. The cells are empty, or rather filled with air, in some parts of plants; but in other parts they receive and transmit fluids."—(*Treatise*, 3.)

M. Mirbel observes, "That leaves consist almost entirely of a plate of this substance, covered on each side by the cuticle. The stems and branches of both annual and perennial plants are invested with it; but in woody parts it is dried up and reproduced continually; such parts only having that reproductive power. The old layers

that remain are pushed outward by the new ones, and form, at length, the ragged, dry, dead covering of the old trunks of trees."—(SMITH'S *Introduction*, ch. 4.)

The cells, at least those of the bark, are, in all probability, the depositories of the secreted proper juices of the plant: the cells of the sugar-cane for instance, contain the saccharine juices of that plant, while those of the sassafras-tree contain the aromatic and oily secretions peculiar to that tree; but it is certain, that, although the cells of the wood contain some of the peculiar flavour of each tree, it is in those of the *bark* that the strength and intensity of the aroma are chiefly resident. The cellular tissue also contains water and air, and there is reason to believe that it is the medium in which, through electro-chemical agency, the whole of the juices of the plant are elaborated, changed, interchanged by attraction, and deposited in their appropriate receptacles.

310. *The conducting vessels* of plants are generally tubes of a cylindrical figure, but varying considerably in construction and appearance in different plants.

If a young green shoot, or leaf-stalk, of the elder (*sambucus nigra*), be held between the forefinger and thumb of each hand, and drawn steadily till it divide asunder, some slender, hair-like filaments will be perceived, which are spirally coiled, and partly unrolled—these are the *spiral vessels*. They were described by Dr. Grew, and by Malpighi, about the close of the seventeenth century. They are composed of white and shining, somewhat flattened fibres, spirally coiled, in a manner closely resembling that of the coiled wire-spring of a bell, and compressed together till they become hollow cylinders; or they wrap round, and enclose other membranous tubes of extreme fineness, which thus, they not only defend and strengthen, but stimulate to action by that elastic pliability which they possess in an eminent degree. These spiral tubes were formerly called *tracheæ*—wind-pipes, and *vasa aëria*—air vessels; because, as has been already mentioned, they were supposed to be empty, or to contain and convey air; and as air is found to exist in the trunks and stems of plants, these vessels were considered as the organs of respiration.

#### SPIRAL VESSELS.

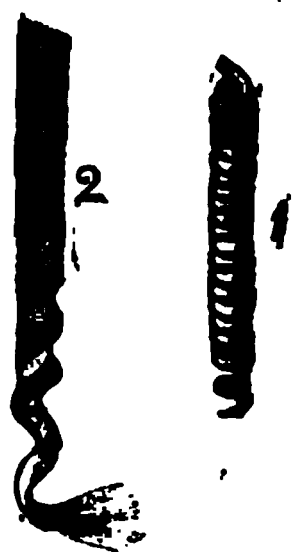
“Spiral vessels are generally seen by learners in an unrolled state, which is the most easy to obtain, but the worst calculated to give a correct idea of their real natures; for what notion can be formed of the original position of their parts, by viewing a parcel of entangled silver threads, glittering in the light, as a mere object of

curiosity! One of the best modes of seeing them is to take a piece of asparagus, in the boiled state in which it is brought to table, and to tear it to pieces in water. By means of a little careful tearing and cleaning, you may extract from the pulp—which is cellular tissue—a quantity of fibrous bundles, which are in part woody fibre, and in part spiral vessels; the elasticity and disposition to unroll, in the latter, being destroyed by the boiling, they may be easily separated in an entire state, when the true position of their internal fibre will be distinctly perceived.—(See *Treatise on Botany*, p. 70.)

Fig. 12 shows the *simple spiral vessel* (1), where the coil appears to consist of one simple continuous fibre; (2) represents a vessel, wherein the fillet is composed of many united fibres.

The strength and tenacity of these minute hairs are surprising; Leuwenhoeck reckoned that 20,000 vessels were contained in about the space of one-nineteenth part of an inch of a piece of oak, which vessels were probably of greater diameter than the generality of the spiral tubes; and Hedwig determined that the largest vessel of a gourd was in diameter but the three thousand four hundred and eightieth part of an inch; yet one or two of these almost invisible fibres, will, if cautiously drawn out, support the weight of a piece of elder twig, of half an inch in length, and the eighth of an inch in breadth; and still evince a power to coil up again, in some degree, if the piece be supported by the finger, so as to take off the pendent weight.

Fig. 12.

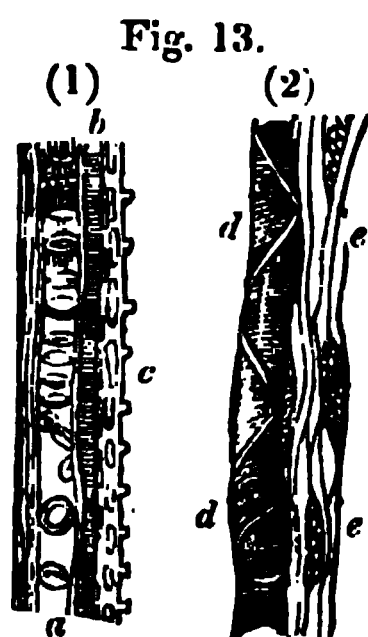


311. *A variety of other vessels*,—supposed to be *conducting tubes*, or at least accessories to the conduction of the sap, are described by authors, and may, in fact, be detected by very minute observation. Both the *Treatises* contain ample descriptions of four or five of these vessels, accompanied with appropriate figures. There exists some doubt, whether the spiral tubes be, or be not, the origin of all the other vessels,—they are certainly found in all young plants, and are the only vessels observed in some plants; still, however, there are modifications which take place in plants as they advance in growth; and some species of vessels are then detected, which were not to be traced in the early stages of their existence. The first *Treatise* insists that one kind of vessel at the least, besides the spirals, must be primitive in its origin, because it exists in some plants as early as these vessels;—it is thus described and figured:—

“The *annular vessel*” (from *annulus*, a ring) “consists of a simple transparent membranous tube distended by rings, which are retained in their places by minute needles, which can be separated

from their vessels in spider-wort (*Tradescantia*) and some other plants."—"The rings are generally separated from one another only by a space equal to their own diameter; but they are occasionally at a distance of six or eight diameters. The annular vessel is found in many plants; and is particularly distinct in spider-wort and balsam."

It is shown at *a*, fig. 13 (1);—adjoining to *a* is a spiral tube, *b*, and a portion of the cellular membrane, *c*.



(2.) The *punctuated vessel* (from *punctum*, a point, spot, or dot), "derives its origin both from the simple spiral and the annular vessel. When the spiral is its original, the spires are separated," (see *d, d*, fig. 13—2,) "and the intervening space filled with a connecting membrane, which is thickly studded with round oval dots. It is the largest in respect to diameter of the vegetable vessels, and in the fasciculi of vessels in the

stems of herbaceous plants, it is always nearest to the bark. It is present in the root, the formed wood of stems, in branches, leaf-stalks, and the midrib of leaves. In old and hard wood, as of the oak and the chesnut, the punctuated vessel appears as if it were branched." This vessel corresponds with the mixed tube of Mirbel (307—*d*)—in the figure, it is represented in contact with the cellular tissue of some hard-wooded tree, *e, e*.

The punctuated vessel, although it somewhat resembles the spiral tube, is distinct from it; in appearance it is semi-transparent,—and it is not in general discovered with that distant spiral thread which is shown at *d, d*, fig. 13. I conjecture that, in the punctuated vessels, we may recognise the *central tubes* of Mr. Knight—those which he says, "the spiral tubes are every where appendages." These, more will be said in future,—but for the present I observe that Mr. Knight appears to consider each *central* vessel as a membranous tube, round which the spiral is either lapped or coiled as a fillet; or, that in consequence of being in close contact with the central vessel, it aids its functions as a conducting vessel, by the springy elasticity which it (the spiral) possesses in so remarkable a degree.

(3.) The *reticulated vessel*, (from *reticulum*, net-work,) "is a modification of the simple spiral, in which the spires having become distant, the interstices are filled up in part with new fibres that pass diagonally from one turn of the spire to another. The whole of the spaces, however, between the spires, are not filled up by branched fibres; and therefore, clefts or openings are left, which, from the reticulated, or net-like aspect they produce, have given rise to the name

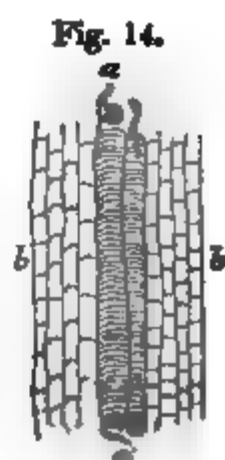
of the vessel. Reticulated vessels are not found in young plants, being the result of a change produced by the advanced growth of the plant. They are found in a few plants only, but in some, as the balsam, (*impatiens balsamina*), at its full growth, they are the only kind of vessel contained in the root, in which part they occur more frequently than in the stem. In the *fasciculi*, (bundles of connected vessels,) they are situated towards the bark."—(*Treatise on Veg. Phys.*, 8.)

(4.) *The beaded vessel* is a variety or modification of the punctated vessel; it is described in the *Treatise* as resembling a chain of oblong, ovate (*i. e.* egg-shaped) cells, or beads, and as found only in knots of the stem and tubercles of the roots, and intended to unite the other vessels with one another.

In the new *Treatise on Botany* (1835), the wood-cut, fig. 13 (1), is thus alluded to; the reader will do well to compare this illustration with that extracted from the original *Treatise* (No. 1) above:—"In the closed duct, the fibre is placed exactly as in the spiral vessel (*see b*); in the *annular* (*see a*), the spires seem broken into rings, which join at their extremities, and give the organ the appearance of a tube partially filled with rings, lying irregularly in the inside."

The office of ducts (for so it appears all the tubes are now styled), is, "to convey fluid at one period of their existence, whatever it may originally have been; for they are certainly filled with sap in such plants as those to which we have just referred" (the *balsam*, and *touch me not*). "Considering their relation, in structure, to spiral vessels, one cannot avoid suspecting that to convey air was their original destination; but, if so, this must have ceased soon after their first creation; for the thinness of their sides, and the very imperfect manner in which they are guarded internally, by fibrous spires, are such, that no resistance would be offered by them to the infiltration of fluid from the tissue that surrounds them."

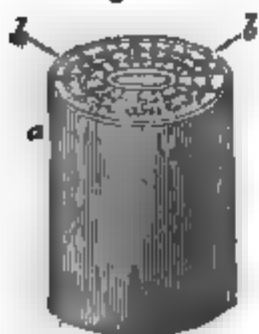
312. *Situation of the Vessels and Cells.*—That of herbaceous plants has been described at paragraph 308, wherein it was shown, that the stems consisted of a cuticle and bark, surrounding a parenchymatous, or pulpy mass of cells. This cellular tissue generally involves bundles of conducting sap-vessels, ascending in a vertical direction the whole length of the stem. Sometimes two or more varieties of vessels are observed in the same stem, the spiral vessels changing to the punctuated, while other simple spirals are formed in a position nearer to, and often surrounding, the pith. At fig. 14 is shown the spiral tubes (*a*) ranged within



the substance of the cellular tissue of simple cells (b), as in the sugar-cane. In the stems of exogenous plants, the spirals are situated round the medulla, or pith: they are found, also, in the leaves, calyx, corolla, stamens, and pistil, but rarely in the bark. In endogens they are found in the centre of every vascular and fibrous bundle; also in the leaves, &c. The *Treatise on Vegetable Physiology* observes, "If the stem of a gourd be examined at different periods of its growth, or in different parts of the plant, between the root and the top of the stem, we shall find that, in the young plant, or at the newly unfolded extremity of the old plant, the vessels are all simple spirals. As the plant advances in age, each of the vessels already formed becomes punctuated, and new spiral vessels appear on the opposite side of the fasciculus; and this transformation of spiral into punctuated vessels proceeds, until all the vessels in the oldest parts of the stem, that are next the root, are punctuated vessels."

313. *Vessels of the woody Stem.*—This species of stem, peculiar to trees and shrubs, has been described at No. 242, as consisting of concentric layers. The layers indicate, in general, the age of the plant, since a new layer of alburnum is added every year in that part of the stem which is contiguous to the bark. But besides these concentric layers, there are other membranous, or cellular masses, which diverge in a horizontal direction from the layer of wood next the pith, to the liber, or inner layer of the bark: these rays are termed medullary rays, (*radii medullares*,) because they formerly were supposed to be derived from the *medulla*, marrow, or pith of the tree\*. The appear to be composed of cellular membrane or tissue. Fig. 15,

Fig. 15.



exhibits a woody stem, wherein *a* represents the bark surrounding three layers of wood, that next the bark being the alburnum, or layer of the present year; *b, b'*, show the convergent or medullary rays proceeding from the innermost layer of wood, that next the pith. But the most beautiful exemplification of the structure of woody stems, is to be found in those natural specimens which are sold by mathematical instrument makers. There is, or was, a set of these prepared specimens, known by the name of "*Custance's vegetable cuttings*:" it consists of twelve slides of box wood, each containing four cuttings or slices of some root or

\* Mr. Knight has asserted that the term ought to be *convergent*, and not *divergent*; because, the bark, being evidently the source from whence these process proceed, and by which they are formed, they must, of necessity, be considered as converging—i. e., tending towards each other, instead of diverging, or spreading more widely apart.

stem, between two fine and transparent pieces of talc. These slices are so prepared as to exhibit the natural vascular structure;—the woody fibre, that encloses the vessels, lying in concentric layers, and the medullary, or convergent processes, crossing them in a horizontal direction. Wood-cuts and drawings are, at best, but tolerable substitutes for these real specimens of Nature's works; though it is not denied, that correct figures may assist the vegetable anatomist in his researches, particularly if they be accompanied by luminous descriptions. It is to be lamented that the descriptions which are given in SIR HUMPHRY DAVY'S *Lectures on Agricultural Chemistry*, are unworthy of his three fine plates. They are, at a remote distance from the figures, very meagre in their allusions, and in fact, do not enter into a minute definition of those parts which are so admirably laid down. The plates represent highly magnified portions of the section: 1st. Of an elm branch, "exhibiting the tubular structure, and silver and spurious grain;" 2nd. Of a part of the branch of an oak; 3rd. Of that of the branch of an ash. The vessels and cells of the bark,—the conducting vessels, or channels through which the vessels passed,—the fibrous tissue of the wood,—the convergent layers, and the cells of the pith,—all are admirably depicted, and with so much nicety, that had the drawings been accompanied by equally minute and precise descriptions, the student could not have failed to acquire most satisfactory information. As it is, however, the plates do little more than exhibit the skill of the draughtsman and engraver, and excite curiosity without gratifying it.

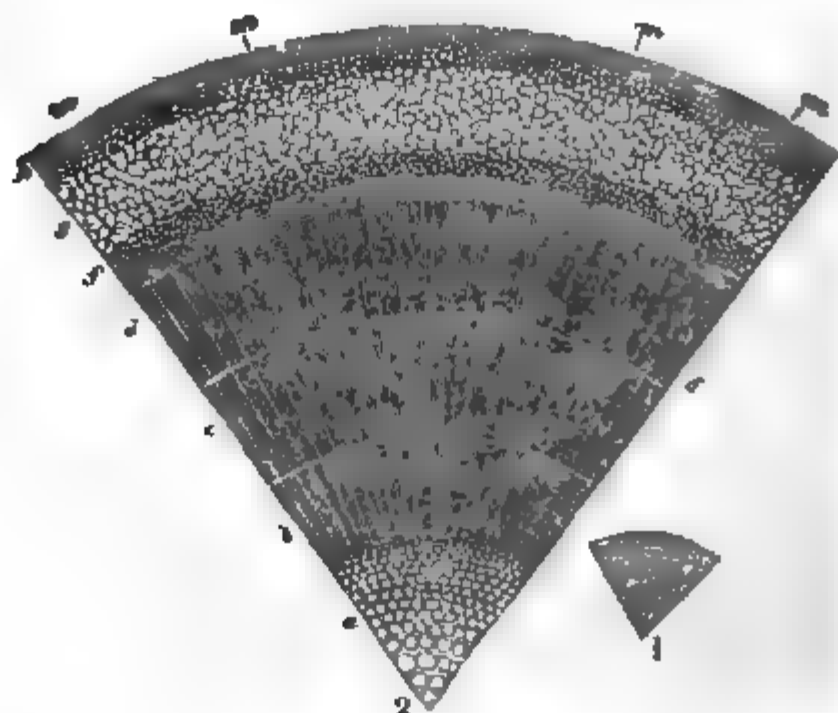
314. If the stem of a young seedling tree, or a tender twig of the growth of the current year, be transversely divided, and an extremely thin slice of it be placed under a magnifying glass of high power, it will exhibit the pith in the centre, surrounded by a single ring of wood, in which may be traced the conducting vessels of the sap. This is the first layer of wood of the yearling shoot in its herbaceous state, beyond and exterior of which, is a circle of bark containing a cellular tissue, and another set of vessels that convey the returning juices: finally, this bark is enclosed, and defended by the epidermis or cuticle. Here then is a young twig or yearling shoot of a tree, in a state little differing from that of an herbaceous plant.

But an object vastly more minute is well worthy of observation; for, if the stalk of a bunch of currants, nay, even if the little pedicle which supports one individual currant be carefully divided, and a thin slice of either be examined by a power of at least two hundred and fifty times, the structure will be found astonishingly complete; cuticle, bark, cellular tissue, vessels, pith, all are there.

In fact, the latter object exhibits an organization of great symmetrical beauty: it contains within the cuticle and bark, a cellular tissue of oblong, or lozenge-shaped cells, arranged in the form of a ring around the wood, if so it may be termed; and this wood exhibits the sap-vessels which supply the berry. They appear like dots in the midst of a slender ring that encloses the pith.

The structure of this minute atom is as complete as that of the young shoot of an oak, or ash tree, in its earliest development; but let that young shoot attain a year's growth, and the case will be altered,—it will then exhibit the perfect structure of a tree or shrub, somewhat resembling that represented in fig. 16, which is a magnified specimen of an *Ash* of the growth of three years. The drawing has been taken from one of those finely executed engravings in *DAVY'S Lectures*, alluded to in par. 313; but here it is greatly diminished.

Fig. 16.



No. 1 is the transverse cutting as it appears to the eye; No. 2 represents the same, magnified; *a*, is the pith; *b*, the inner concentric ligneous layer of the first year, now the true wood; the medullary sheath is situated between *a* and *b* just at the point where the convergent rays approach the pith; *c*, is the layer of wood less matured of the second year; the sap-vessels therein are more apparent; *d*, is the outermost, or recently formed concentric layer, or the *alburnum*, in which the large sap-vessels, *e*, are very visible; *f*, is the *liber*, or new bark, with the reducent vessels; *g*, the *parenchyma*, or cellular tissue of the bark; *h*, the outer bark, and

its vessels; *m, m, m, m*, point to the direction of the *medullary*, or convergent layers, 25 of which are drawn in the figure.

Of these rays, or layers, *Radii medullares*, the *Treatise on Vegetable Physiology* observes: "The flattened masses of cellular tissue, which compose these, consist of oblong cells, resembling the oblong cells which surround the vessels, except that they are horizontally arranged. These stretch from the first layer in the centre to the surface of the wood; and are there opposed by others situated in the *liber*, or inner bark. In these rays the cells are more numerous in the middle of the mass; so that in a vertical section of a stem, they appear to be of a lozenge shape." The cellular texture of the medullary rays has led them to be regarded as processes of the pith; "but that this is an error seems evident, for the first layer of wood, the one next the pith, has no medullary rays traversing it, although every subsequent layer is crossed by them. It consists of small oblong cells imbedding a circle of simple spiral vessels, and a cellular lining or sheath which is interposed between the pith and the spiral tubes." If the reader who possesses the last edition of DAVY'S *Agricultural Lectures*, that of 1827, compare the plates therein, which have been alluded to, with fig. 14 above, and the foregoing definition; and particularly, if he attentively examine the beautiful natural specimens in CUSTANCE'S *Cuttings*, he will not fail to acquire some practical information concerning that astonishing structure, which may be traced throughout the whole of the works of the vegetable kingdom.

315. *Vessels of the Leaves*.—Leaves exhibit a vascular, cellular, and cuticular system or texture. In the first, the *vascular*; bundles of sap vessels enter the leaf through its footstalk, and are distributed throughout the minutest fibres which compose the network: the spiral vessels in particular, may be detected in the midrib, and in all its ramifications. In the *cellular* system, a mass of cells, which constitutes the chief bulk, and forms the colouring matter, may be traced in all leaves. These cells vary much in their form; in some leaves they are globular, in others oval, tubular, or of a cylindrical figure. They are connected with pores which open through the cuticle, and these pores, and the cuticle that covers or lines them, form the *cuticular* system of the leaf. The following comprehensive view of the structure of the leaves has been taken from SIR HUMPHRY DAVY'S *Third Agricultural Lecture*, wherein also is a fine plate of a portion of a vine leaf highly magnified, "cut so as to exhibit the tracheæ" (*spiral vessels*), and "copied from GREW'S *Anatomy of Plants*."

"The leaves, the great sources of the permanent beauty of vege-

tation, though infinitely diversified in their forms, are in all cases similar in interior organization, and perform the same functions. The alburnum spreads itself from the foot-stalks into the very extremity of the leaf; it retains its vascular system and its living powers, and its peculiar tubes, particularly the tracheæ (spiral vessels), may be distinctly seen in the leaf. The green membranous substance may be considered as an extension of the parenchyma, and the fine and thin covering as the epidermis. Thus the organization of the roots and branches may be traced in the leaves, which present a more perfect, refined, and minute structure.

“On the *upper surface* of leaves, which is exposed to the sun, the epidermis is thick but transparent, and is composed of matter—possessed of little organization, which is either principally earthy or—consists of some homogeneous chemical substance. In the grasses it— is partly siliceous; in the laurel, resinous, and in the maple and thorn it is principally constituted by a substance analogous to wax— By these arrangements, any evaporation, except from the appropriate tubes, is prevented.

“On the *lower surface*, the epidermis is a thin transparent— membrane full of cavities, and it is probably altogether by the— surface that the moisture and the principles of the atmosphere— necessary to vegetation are absorbed.”

316. The *conducting sap vessels* enter the leaf through the foot-stalk, and generally in as many bundles (*fasciculi*) as there are divisions in the leaf: thus, in a transverse cutting of the footstalk of an elder-leaf, five distinct bundles of vessels, that is, five masses having a more opaque appearance than the cellular substance which surrounds them, may be perceived\*. These masses are bundles of

\* Vegetable physiologists have long been in the habit of describing the opaque cords above alluded to as *sap-vessels*, in contradistinction to those receptacles, or cells, through which they pass. Subsequent to the appearance of the first edition, in which, as is evident, I adhered to the then received opinion,—the luminous letters of Mr. Knight have induced me to view the *cellular system*, or that which is manifestly replete with fluids, as the conduit of the sap. In fact, the opaque bundles bear the appearance of masses of *fibres*, the office of which it may be shrewdly conjectured, is purely mechanical. The fibres give firmness and flexibility to the vegetable body; they appear to be cords or tendons, and in all probability act as such.

The subject is surrounded with difficulties, and the extreme minuteness of the parts presents obstacles to correct research: the *vital principle* is secret in its agency; but, in the absence of positive evidence, there are facts which prove, that the *cells* contain fluid; these cells, therefore, may be presumed to be the medium of its conduction.

One especial caution ought to be impressed upon the inquiring mind, and this has been generally overlooked. All the experiments upon which the *theories* of

vessels, one of which is given off to each lobe or leaflet; and thus the number of the fasciculi is usually regulated by that of the leaflets, of which the leaf is composed. From these bundles, branches are sent off in every direction, and these branches constitute that which is termed the skeleton of the leaf. On this subject Keith observes:

“In simple leaves, whether petiolate or sessile, the fibres of the petiole or base, branch out into several large and principal nerves, expanding like the ribs of a fan, and diminishing in size as they elongate by means of the ramifications they send out, till they are at last lost in the margins. But the circumstance which is most singular is, that the fibres are not only subdivided into a variety of ramifications forming a fine net-work, but that the net-work is double, consisting of two layers; the one corresponding to the upper, and the other to the under surface of the leaf. Hollman detected and separated them in the leaf of the pear-tree, and Linnæus in the leaf both of the pear and apple-tree. He even discovered their points of union, and remarked that the net-work corresponding to the under surface was much less firm and compact in its texture than that corresponding to the upper surface. Hedwig discovered two layers, even in the minute and tender leaf of *Sphagnum palustre*, and affirms that he found in the leaves of the pear and orange-trees, three layers of net-work, which I have not indeed been able to detect in the former. But no language is able to convey an adequate idea of the delicacy and intricacy of the web. It must be inspected as it exists in the contexture, or rather in the decay of the leaf, whole leaves being often found reduced to a skeleton of fibres in the winter or spring, lying at the roots of trees in situations where they have not been dispersed by the wind. But if they are not found ready prepared, as in this case, the dissector must have recourse to maceration.”—(*Phys. Botany*, vol. i. 274.)

This double system of net-work, when viewed in connexion with

*the cause of the sap are based*, have been formed from observations upon the effect of coloured infusions, absorbed by cuttings of twigs or stems. Now,—such cuttings are pure amputations—parts dissevered from the vegetable body, which, in a state of growth was actuated by the *vital principle*: they are mutilations, and can afford no correct evidence of the functions of the vegetable organs or vessels while under a natural stimulus: this fact, which I have insisted upon more than seven years, in various papers written for scientific periodicals, received the sanction of Mr. Knight, and accords with what has appeared, subsequently, at page 71 of the *Treatise on Botany*, 1835; it ought never to be lost sight of in physiological investigations.

the very different functions performed by the two surfaces of the leaves, leads to the conjecture that the two sets of vessels are appropriated to the performance of two distinct offices. Some very interesting experiments of Darwin and Knight have tended to throw much light upon the subject. One set of vessels is probably accessory to the conducting sap-vessels of the stem, and is distributed among the cells connected with the porous system of the leaf, from which another set conducts the now elaborated juice into other channels, by which it is conveyed into the reducent vessels of the bark.

*With respect to the cellular structure of leaves, the Treatise* observes, that "all leaves are chiefly made up of cellular tissue. The cells present a variety of forms, as they happen to be more or less compressed; but the prevailing forms are the globe and hexagon. In all leaves, the cells immediately under the cuticle of the upper surface, differ from those of the lower. If the leaf of the Christmas rose (*Helleborus niger*) be selected to illustrate this difference of structure in the same leaf, we shall find a range of tubular cells, which terminate in the pulp of the leaf, immediately under the cutis of the upper surface, while those next the lower disc are irregular hexagons."

317. *Reducent, or Returning Vessels.*—These vessels have their origin in the leaf; the sap vessels are closely accompanied by them, in each rib of the leaf, but they separate in the footstalk, at its junction with the twig; the sap vessels passing from the central part of the latter, while the returning vessels enter into the bark of the twig. In the elder, five sets of returning vessels, that is, one from each leaflet, are discernible in the bark of the footstalk, and thence they pass into the bark of the twig and stem. The returning vessels, says the *Treatise*, "run in straight parallel fasciculi (or bundles), close to the wood; but as a new layer of these is added every year, and the former layers are pushed outwards, these at a distance from the wood separate from one another, and produce a mass of net-work, the meshes of which are filled with cellular matter. Each vessel is a simple entire tube\*. The vessels in the bark of trees and shrubs, which have a copious thick juice, are arranged round reservoirs of this juice, in the same manner as the oblong cells are arranged around the other vessels; but in herbaceous plants, those in which the vessels are distributed in distinct bundles through the parenchyma, they form part of each fasciculus, in conjunction with spiral or annular vessels."—(*Treatise*, page 9.)

\* These vessels are the *simple tubes* of Mirbel.—See 307, *f*; the meshes are exhibited in Fig. 21, No. 405.

## PART III.

## FUNCTIONS OF THE VEGETABLE ORGANS.

318. *Functions of the Root.*—The root is familiarly understood to be the part by which a plant attaches itself to the soil, and imbibes the nutritive fluids that are by it transmitted to the remotest members of the vegetable structure.

To this, however, there are a few exceptions, for all roots are not attached to the soil. Some plants float in water, and are furnished with a spongy mass or knob, through which they derive support; others obtain food altogether from the atmosphere, being, to all appearance, destitute of any organs that correspond to those of roots in the common acceptation of the term. But these are exceptions to the general law, and therefore are to be regarded only as such, although they afford strong corroborative testimony to the hypothesis of the electric agency of membrane\*. In order to comprehend the functions of roots, properly so called, it will be necessary to take a philosophical view of the structure of those organs, and to investigate the mode in which their developements are effected.

The main stem of a root corresponds in a great degree with the ascending trunk that it supports,—thus, when the plant is strictly *annual*, the root consists of little else than a cellular substance, involving bundles of vessels, and enclosed by a cellular bark and cuticle. When it is herbaceous and *perennial*, the structure of the root admits of a great variety of modifications, some of which—at least at an advanced period of its growth—are not dissimilar from those of plants with woody stems. The root of trees and shrubs consists of two parts—the trunk or descending stem (*caudex descendens*) of Linnæus—and its divisions or radicles (*radicula*). The former, in common with the ascending stem, is composed of an external cuticle, enclosing a pulp, cortical and ligneous layers, convergent processes, a central pith, and systems of conducting and returning vessels, all arranged in due order and symmetry.

It is most interesting and curious to observe the simultaneous evolution of the several members of the vegetating plant, even in situations diametrically opposite the one to the other. Every plant, whether it be annual, perennial, or arborous, possesses in itself a principle of developement which is strictly annual: thus in trees, whose periods of duration may extend to centuries, there is a system of buds and leaves, which buds, &c., as they advance in growth, and

\* See the Theory of Dutrochet, No. 395 to 396.

expand their surfaces in their peculiar appropriate medium of nutrition—the atmosphere—produce and propel (through the chemical agency of that fluid, when excited by the electrizing principle of light) a corresponding system of descending fibrous processes, which penetrate to, and through, the fibres of the existing roots, and become partly the permanent, and partly the temporary organs of supply to the advancing shoots and leaves.

Keith, in his general remarks on the roots of plants, observes that, “The fibres thus issuing from the caudex to which they are generally lateral, are again furnished with still smaller fibres lateral to themselves, and terminating at last in fine capillary, and often transparent points, which are said to be renewed annually (*Physique des Arbres*, liv. i. ch. 5); being originally protruded in the spring, perishing in the winter, and again succeeded by a new set in the spring following. Hence they seem to bear the same relation to the root that the leaves bear to the stem or branch.” (Vol. i. 40.)

On the question concerning that system of fibres which is said to perish annually, I observe, that it appears unphilosophical to consider any parts of the root to be fugacious and perishable which have been propelled by the permanent members of the tree: such are the *radicellæ* or rootlets attached to the young shoots of the past year. But those minute fibres which are devoted solely to the leaves, must be presumed to become inert, and finally extinct, since the members to which they were the organs of nutrition, are strictly annual and deciduous. Such I conceive are those *fibrillæ* and *spongiolæ*, which, with the more permanent *radicellæ*, I now proceed, on the authority of the *Treatise*, shortly to describe.

319. The *radicellæ*, rootlets,—“whether of ligneous or herbaceous plants, project at right angles with the surface of the caudex, or the branch in which they are seated. The rootlets that issue from the caudex of the root and the branches, proceed from the medullary sheath, and are united with the vascular fasciculi of the ligneous part of the root; but from whatever part they originate, rootlets consist of one large fasciculus of punctuated sap-vessels, generally arranged in rays, and enclosed in a cellular bark.”

320. The *Fibrillæ* (fibrils or threads) consist of two parts: the slender, hair-like threads, which branch from the rootlet, and the *spongiolæ* (little sponges) that are seated upon their sides. “The *fibrils* consist of a central fasciculus of vessels enclosed by a cellular cortex and cuticle; the *spongelets* are oblong, oval, spongy bodies, very minute, and found only on the fibrils. When examined under the microscope, they are found to consist of a porous cuticle, enclosing a circle of hexagonal cells. These cells surround a bundle

of vessels which open into" (or, as it is termed, *anastomose*, from *ava*, *ana*, upon or through, and *στομα*, *stoma*, a mouth) "the cells of the fibril." The spongiolæ are not easily detected, unless the roots have been most cautiously removed from the earth, so as not to injure their delicate appendages. They should then be investigated under water, in which situation they expand, and project from the sides of the fibrils.

This view of the position of spongelets, appears to me overcoloured or incorrect: a student may seek in vain for such organs. But if the ball of a young vine, or erythrina, growing in a pot, be turned out, there will be seen at the termination of each advancing root, a process of a peculiar form, not unlike that of a sharp-pointed awl. In colour, it is more or less green, and it is somewhat thicker above the point than the rootlet from which it proceeds. This is the spongy process of that root or fibre, and it appears to perform the office of a *piercer*, as well as that of an *absorber* of fluids. Infinite modifications of form may, doubtless, be admitted, but something approaching to a correct idea of the organ in question may be obtained by the investigation thus proposed.

By referring to what I have said on the elaboration of the food plants, and its introsusception into the fine vessels of the root (103—c), the reader will more readily appreciate the philosophy of the annexed observations.—"Some late experiments of M. Dutrochet have thrown great light upon the functions of these minute bodies: they render it probable that these fibrils imbibe the fluid from the soil through the cuticle, aided by electrical influence; and the cells swelling, push the fluid into the vessels, through which it rises, forced upwards by the impulse given to it by the continual imbibing of the swollen cells, and the resistance opposed to distention by their sides, and those of the vessels through which it rises."—(*Treatise*, p. 14.)

321. *Functions of the Vegetable Epidermis*.—This important membrane is designed not only to protect and give form to the parts it encloses, but to afford free ingress and egress to moisture, and to establish a communication between the gaseous nutritive fluids of the atmosphere, and the denser fluids within the cortical pulp. On the structure of this membrane, authors are at considerable variance\*. "Saussure the elder, whose observations on the epidermis are chiefly confined to the leaves and petals of the jessamine and foxglove, describes it as constituting a bark composed of two layers; the interior layer consisting of a net-work, which he

\* Compare 242 of the first Section on *Vegetable Physiology*.

calls the cortical net-work, interspersed with a multiplicity of what he calls cortical glands; and the exterior layer consisting of a fine and transparent membrane, which he regards as the true epidermis, capable of being partly detached, but totally destitute of organization."

(a.) Dr. Smith considers that this part allows of the passage of air, as is proved by experiments on the functions of leaves. "Light probably acts through it, as the cuticle is a colourless membrane. We know the effects of light to be very important in the vegetable economy."

(b.) Keith, who has investigated a great many authorities, observes that he has never been able to satisfy himself of the existence of the unorganized cuticle of Saussure, alluded to above,—“I have observed, indeed,” he says, “though very rarely, in the epidermis of the leaf of the honeysuckle, *Lonicera periclymenum*, a small portion of external pellicle of greater extent than the area of the meshes, in which no vestige of the meshes was to be found, and which seemed, like Saussure’s outer pellicle, or true epidermis, to be totally destitute of organization.”

(c.) Hedwig, whose dexterity in experiments of this kind was certainly not inferior to Saussure’s, admits the existence of two distinct laminæ in the net-work of the epidermis, which, however, he acknowledges he was never able to separate, but does not represent the exterior pellicle as being destitute of organization.

(d.) Decandolle found no pores in the epidermis of fleshy fruits, such as pears, peaches, and gooseberries,—nor in that of roots or scales of bulbs,—nor in any part not exposed to the influence of air and light.

(e.) The *Treatise on Vegetable Physiology* says, “In young annual plants, it is applied so closely over the cellular tissue, as to be scarcely separable from it; but, in perennial plants, it is annually reproduced, and the old epidermis pushed outwards. The doubling of layers thus accumulated, has led to the erroneous opinion that it consists of several layers.”—“The epidermis is generally supposed to be perforated by the organic pores which are found on some parts of the surface of the plant; but it is probable that it enters these pores as a lining membrane, instead of being perforated.”

“It gives free passage to moisture, and exhales or gives out vapour, and absorbs or sucks it in; and it performs the latter function independently of pores, which cannot be detected on the absorbing surfaces by the most powerful microscopes.”—(Pp. 9 and 10.)

322. The reader who is desirous of further information may find

ample store of it in the works I have referred to. In the mean time, remark that it appears certain, that herbaceous plants, and the soft parts of woody plants, do absorb, inhale, and exhale moisture and gases through the porous meshes of the epidermis; therefore, though there be but few *oscular pores* in any part of this exterior covering, except in that portion of it which forms the surface of the leaves; yet it is beyond a doubt that the microscope discovers a network composed of numberless meshes in the cuticle of the fruit, and various other parts of the vegetable structure; the skin of the red currant-berry, in particular, I have found to be reticulated in a manner so striking, as to render it one of the most beautiful of microscopic objects. The layers are double, according to Keith, in the epidermis of apples, and, in all probability, in that of other fruits; the exterior layer being thin and transparent, and the interior layer more succulent and tender, tinged with the peculiar shade which gives colour to the fruit. If, after all, the existence of pores is denied, while the passage of moisture and of gases is admitted, it may be safely contended that this function of the epidermis is performed through the agency of electric attraction between the lighter fluids of the atmosphere, and the denser fluids of the plant.

323. *Functions of the Cellular Membrane.*—This membrane is visible into two portions: the first is that which, in woody plants, surrounds the returning vessels of the bark; and, in *herbaceous plants*, it is that part of their tissue which corresponds in situation with the cellular membrane of the bark of trees, and contains the elaborated or perfected juices of the vegetable. The second portion consists of those cells which, in woody plants, surround the conducting sap-vessels; and which, in herbaceous plants, are situated nearer the centre of the plant than the first portion, and contain the starchy and immature juices of the vegetable. Speaking of the cellular membrane, the *Treatise* observes, that the cells are so constructed “that there is every reason for believing that the functions of secretion and nutrition are performed solely by the cellular tissue. The influence of vitality is thus beautifully displayed; the cells of a living plant, swollen with fluids, retain, during life, their figure, range the fluids they contain into others of the most opposite quality, and constitute a sufficient barrier to prevent them from mingling together: but as soon as life is extinct, the sides of the cells yield, the secretions mingle, and, if circumstances be favourable, decomposition proceeds, permitting the chemical affinities, which had been controlled during the life of the plant, again to exert their influence.”—(Page 4.)

324. *The Electrical Theory considers the Cells as the Laboratories* as well as the depositories, of peculiar fluids, wherein the watery juices conveyed through the sap-vessels, are acted upon by those specific electric attractions which take place between bodies of different degrees of density, provided their component elements be in a condition favourable to the forming of new combinations. This electro-divellent attraction is exemplified in the process of vinous fermentation; and there is every reason to believe that it is exerted between compound fluids of different specific gravities, through the medium of that membranous barrier which composes the utricle or bladder of the cells, although the texture of that barrier is of sufficient firmness to prevent the blending of the fluids they contain, by the act of simple mixture. Thus, electro-chemical changes in the constituent elements of vegetable fluids, are effected during the annual progress of the plant, till at length, the processes of nutrition and fructification are fully completed.

325. *The Cells of the Bark*, in like manner, are laboratories wherein chemical changes are effected on the juices therein contained. They enclose the returning vessels which convey the fluids that have been partly elaborated in the leaves, and by lateral attraction become replete with those fluids which they finally convert into mucilage, sugar, fat oils, essential oils, resin, and other hydrocarbonous substances. Thus, the cellular system of the interior parts of the plant—that which envelopes the conducting vessels—may be considered as the more immediate organ of *nutrition*; and the cellular system of the bark, as a medium of *elaboration*, and also a repository of the perfected and specific juices of the plant.

326. *Functions of the Medullary or Convergent Rays*.—Something has already been said of the structure of these rays or layers at No. 314; but, in order to determine their precise functions, it will be necessary to enter upon a more particular inquiry concerning their texture and original source.

The *texture of the Rays* appears to be altogether cellular. Keith says that they are soluble in fluids, in which respect they differ from the fibrous or ligneous layers. Du-Hamel\* macerated for a long time, a piece of the trunk of an oak-tree in water, in which the divergent layers are soluble, and thus laid bare to view the net-like structure of the woody fibre. If a thin slice of one of the divergent

\* Du-Hamel (Henri Louis du Hamel du Monceau), author of "*La Physique des Arbres*," and other celebrated works, was an eminent French agriculturist and natural philosopher; he was also a member of the Royal Society of London, and devoted his whole life to scientific pursuits. He was born at Paris in 1700, and died at the age of eighty-two years.

layers of the oak or elm, be put under a microscope, "it will be found to be composed of an assemblage of parallel fibres or threads of contiguous vesicles, not forming a net-work, but closely crowded together, and compressed into a thin layer, being apparently nothing more than the vesicles or cellular tissue of the pulp that originally existed in the alburnum, now deprived of its parenchyma, but still filling up the interstices of the concentric layers, and binding them together like a cement."—(*Phys. Botany*, i. 336.)

327. In *Herbaceous Plants* the convergent rays are not traceable until the plants have produced seed; they then become visible. This fact leads to the idea, that the developement of these lateral layers is connected with the phenomena of maturation. It would be interesting to compare, by strict investigation, the effect of *ringing* herbaceous stems, with a view to induce premature fertility, with the results of the natural process of seed-bearing. If ringing should cause the earlier production of these processes, it would tend to confirm the suspicion that I entertain, "that one of their offices is to regulate the sympathies which exist between the vessels of nutrition, and those of fructification."—(See No. 87.)

328. *Origin of the Rays*.—Du-Hamel erroneously conceived that they originated in the pith. "If Du-Hamel," Keith observes, "had but happened to attend to the phenomena relative to the point in question, which some of his own experiments were the best calculated to exhibit, he would readily have found the true solution of the difficulty. This, however, has been furnished by Mr. Knight, who, in tracing the result of the operation of budding, observed that the wood formed under the bark of the inserted bud, unites indeed confusedly with the stock, though still possessing the character and properties of the wood from which it was taken, and exhibiting *divergent layers of new formation*, which originate evidently in the bark, and terminate at the line of union between the graft and stock."—(*Phil. Trans.* 1803.) Also, if a portion of the stem of a tree is decorticated, so as to leave the surface of the alburnum exposed to the air for any considerable length of time, there is no further vegetation on that part of the alburnum. But if the wound is not very large, it will again close up, first by means of the production of a new bark issuing from the edges, and gradually narrowing the extent of the wound, and then by the production of new layers of wood, formed under the bark as before. The new wood will not indeed unite with the portion of alburnum that had been exposed to the air: but it will exhibit, on a horizontal section, the same traces of divergent layers as before, extending from the bark in which they originate to the lifeless surface of the old wood

within. It is evident, therefore, that the divergent layers are formed, not from the pith, but from the proper juice descending through the channel of the bark, and are synchronous\* in their formation with that of the concentric layers through which they pass."

329. *Deductions and Remarks.*—The texture of the convergent layers being cellular, and their origin, the *liber*, or inner bark of the current year, may it not be concluded that they are designed to convey a portion of the laborated fluids of the bark laterally, through the substance of the woods, and also to be the repositories of such fluids? The wood, we know, partakes in a degree of the specific qualities of the essential aroma of the bark; it therefore must, by some means, be impregnated by its juices: but how can it be so impregnated, unless by lateral diffusion? Mr. Knight's hypothesis of the progressive induration of the wood of trees, tends to confirm, and at the same time acquires weight from, the theory of the lateral agency of the divergent rays.

He believes that the superior quality of winter-felled timber, and the conversion of the alburnum or sap-wood into timber, are attributable to the matter deposited in the alburnum during the preceding summer, and partially, though not totally, carried off in the spring. Now, the innermost of the concentric layers, the *heart-wood*, retains some moisture, although the ascending current of the sap is restricted almost entirely to the newly-formed wood (*alburnum*) of the current year. The wood also partakes throughout of a certain portion of the specific resinous, oleaginous, or aromatic qualities of the bark, although the ascending fluids which pass through the sap-vessels have been from the first, and continue to be, insipid or nearly void of flavour and odour. How then can we account for the qualities acquired by the wood, unless we admit of lateral conduction and diffusion? From fact as well as analogy, I am therefore inclined to believe that the divergent layers are the organs through which the connexion between the old wood and the newly-formed vegetative parts of the tree is established and kept up,—and that they supply the wood with resinous matters, by which it is not only preserved from decay, but improved in quality, long after the vegetative powers of that wood have ceased. Finally, the divergent rays, from their peculiar position, may act as bonds of union, extending in a transverse direction, filling up interstices, and binding the concentric layers into one solid, firm, and compact body.

\* The term signifies coincidence in time; it is derived from *συμ*, *syn*, with or agreeing with; and *χρονος*, *chronos*, time.

330. *Functions of the Conducting Vessels.*—Mr. Knight thus expresses himself:—"The medullary processes are formed convergently from the bark—they are permeable to fluids; for when the bark is taken off in spring, a fluid is seen to exude from them which, under favourable circumstances, will become *perfect bark*: when the bark remains on, and is performing its natural office, I entertain no doubt but that those processes are the *anastomizing* vessels of the vegetable world, which carry such portion of the sap that has descended down the bark, and is not expended in affording the matter of the new layer of wood, inwardly, to join the ascending alburnous current." This appears to be a truly philosophical hypothesis; for, the bundles of processes, which heretofore have been regarded as the ascending sap-vessels, are dry, and of a fibrous texture: fluids may occasionally be found among them; but the *cells* are always full: I therefore yield to the force of evidence, and avow myself a convert to the doctrine of Mr. Knight, regarding the *cellular system*, as the medium through which the sap is regularly conducted.

331. The *Spiral* vessels have been supposed to be accessaries to the sap-vessels, if indeed they themselves be not the direct channels of the sap. Others, and perhaps justly, view them as air-tubes: it is observed "that there appears to be no provision for the conveyance of air through the central parts of plants, if that office is not performed by the spiral vessels."

332. *May not the spiral tubes act as springs?* for their elasticity is prodigious. They exist in almost all plants; and the peculiarity of their structure, which closely resembles the coiled spring of a bell-wire, argues strongly that they have other functions allotted to them than that of merely conducting the sap! If, indeed, they are appendages to the sap-vessels; if they wrap round and enclose,—or are themselves placed internally within the membranous coat of those vessels,—and I am much inclined to believe they are so,—for the closest observation on the vessels of the flower-stalk of the wild hyacinth (*Scilla nutans*), convinces me that the spiral coil is by no means closely compressed, but is apparently enclosed by, or encloses a fine filmy membrane;—if this be the case, then indeed these spiral vessels may be most efficient mechanical agents in propelling upwards the ascending sap. The pliancy of trees, the readiness with which they yield to the force of winds, and the facility and spring with which they recover their upright position, are facts strongly favouring the idea that they contain internal springs, which, like a coil of wire, are capable of receiving and supporting motion in every direction, without offering impediment or sustaining injury. It is

possible also, that the spiral vessels are peculiar instruments of electrical conduction, whose office it is to distribute that fluid laterally, from every coil, by acting as electric *helixes*. The helix (*helix*, a worm) is a coil of wire wrapped round with silk, and formed into a cylinder; it is often made use of to communicate magnetism to a needle, suspended in the centre of the cylindrical coil, for the electric fluid is supposed to pass with a tangential force from every coil of the wire, laterally, into the enclosed needle. This idea of one of the offices of the spiral tubes, may not appear altogether visionary, when we come to consider the theory of M. Dutrochet, in connexion with the cause of the ascent of the sap, and the processes of vegetable nutrition.

333. *Functions of the Leaves*.—The leaves are among the most important of all the vegetable organs, inasmuch as the life of the plant may be said to depend upon them, they being the organs of respiration, perspiration, and of the elaboration of the nutritive and specific fluids of the plant.

“One great use of the leaves,” Sir Humphry Davy observes, “is, for the exposure of the sap to the influence of the air, heat, and light. Their surface is extensive, the tubes and cells very delicate, and their texture porous and transparent. In the leaves much of the water of the sap is evaporated; it is combined with new principles, and fitted for its organizing functions, and probably passes, in its prepared state, from the extreme tubes of the alburnum into the ramifications of the cortical tubes, and then descends through the bark.

“There can be no question of the general purpose answered to the vegetable constitution by these functions of the leaves. They confirm Mr. Knight’s theory of vegetation, who has proved that very little alburnum or new wood is secreted when light is kept from the leaves. They also help us to understand how essential oils may be produced, which are known, as well as sugar, to be composed of oxygen, hydrogen, and carbon in different proportions. We can now have a general idea how the nutritious sap, acted upon by all the agents above mentioned,” (light, heat, and atmospheric air,) “during its stay in the cellular substance of the leaf, and returned from thence impregnated with them, into the bark, may prove the source of increase, and of peculiar secretions in the vegetable frame.” —(SMITH’S *Introduction*, c. 16.)

334. *The Leaves are made up in a great degree of cellular tissue*, the vesicles or bladders of which are generally distended with a greenish fluid. Sap vessels are distributed throughout the leaf, through the veins or nerves detached from the midrib, and supply

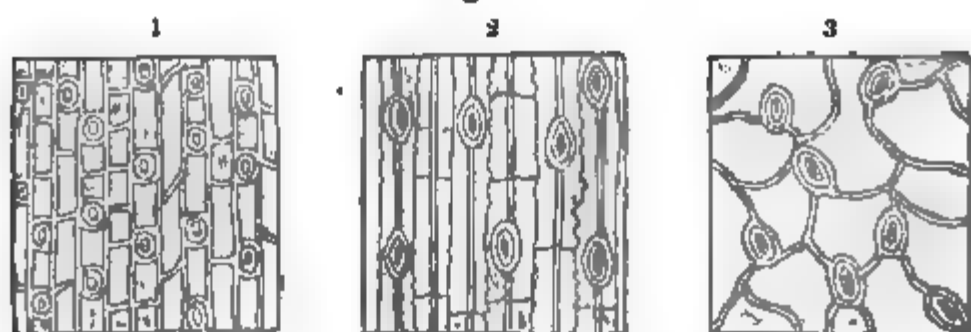
these vesicles, which communicate with the external air, by means of oscular porous openings in the cuticle of the leaf. The *Treatise* thus describes the organic pores: "Every leaf has a cuticular covering, which is composed of two distinct parts; 1. The *epidermis*, which forms the exterior covering of the leaf, in common with every other part of the surface of the plant, adhering firmly to the cutis below it, and entering into every pore; 2. The *cutis*, which consists of a vascular net-work laid upon a layer of air cells. This vascular net-work is made up of lymphatic vessels, the meshes of which assume various forms in different plants, but maintain always the same form in the same plant. A powerful microscope is requisite for ascertaining the following particulars. In plants, the leaves of which have parallel costæ, these meshes are irregular parallelograms, as in Spiderwort (*Tradescantia*): sometimes the vessels are slightly undulated, as in the leaf of the White Lily (*Lilium candidum*), &c.

335. "The size of these meshes differs in different plants; they are always larger than the diameter of the cells of the parenchymatous part of the leaf; but in some plants are so minute, that 55,296 are contained within a square inch of surface. This cuticular layer is perforated with organic pores or slits (*pori corticales*), which, as they perform a most important function in the vegetable economy, shall be examined a little in detail. The organic pores of leaves were first noticed by Grew; they have since been more particularly investigated by Hedwig, Rudolphi, Link, Keiser, and Scandolle, who examined them in six hundred plants. They are found on the *inferior* surface or disc of the leaves of trees and shrubs, and on both surfaces of those of almost all the herbaceous plants." (page 25.)

The reader who is desirous of obtaining minute information on cuticular structure and functions of leaves, is referred to the 6th chapter of the *Treatise on Vegetable Physiology*. The author has arranged the pores under six divisions, accompanying the arrangement with descriptive figures, which, though they cannot be deemed ideal portraits or likenesses, are calculated to convey an idea of the general construction of the cuticular system. The three annexed plates may answer a similar purpose: they are not exact portraits, but sufficiently characteristic to be of some service to the juvenile microscopic observer, in directing his attention to the reticulated and structure of the cutis or true skin. It will be proper to premise that in plants with one seed-lobe (monocotyledons), the veins of the leaf are continued in parallel lines,—hence they are said to be parallel ribs (*costæ*) from the base or leaf-stalk, to the point

(*aper*). The leaves of corn, grasses, orchises, &c., furnish familiar examples of the simplicity of this structure; and in general their porous system is not difficult of detection.

Fig. 17.



In the adjoining fig. 17, No. 1, represents the net-work of the cutis on the under side of the leaf of a plant with parallel costæ. The bulbiferous lily (*Lilium Bulbiferum*), was the subject by which the idea was suggested. No. 2, will convey an idea of the singular wavy net-work of Indian corn (*Zea Mays*). No. 3, represents the general structure of the net-work and pores of those plants whose seeds have two lobes, and which therefore are styled *dicotyledons* (254), their leaves are not furnished with regular or parallel ribs; in them the vascular net-work assumes a vast diversity of form, it is waved and curved in different directions, but its structure, though complicated, exhibits the most beautiful configuration.

I speak experimentally, when I observe, that I not only have been able to detect the porous system on every subject with parallel costæ, which I thought it needful to investigate, without nitrous acid or any other chemical agent, but also that of the leaves of trees and herbaceous plants in general. The leaves of sage, of the primula and of other plants with rough surfaces, present indeed some difficulties: but still, if the leaf be held between the forefinger and thumb of each hand, and then be rent by moving the hands across in an oblique direction, enough of the cutis may be very frequently laid bare, to afford a very satisfactory observation. Sometimes the lancet will raise an atom of a line or two in diameter, and this may be found to contain twenty or thirty pores.

The term *ocular* pore is derived from the Latin word *oculus*, a little mouth, which indeed the pore itself well represents. (See the *Treatise* fig. 68 and 69, and the succeeding judicious observations.)

336. The number of the pores, varies exceedingly: at page 27 of the *Treatise on Vegetable Physiology*, there is a table containing an enumeration of the pores, which have been observed on about thirty different plants; from that table the following have been selected, as being most familiarly known:—

Names of Plants, on the Leaves of which the Pores have been counted.	Number of Pores on One Square Inch of Surface.	
	On Upper Surface.	On Lower Surface.
<i>Dianthus Caryophyllus</i> , or Clove-Pink .	38,500	38,500
<i>Daphne Mezereum</i> , or common Mezereon	None.	4,000
<i>Peonia</i> , or Piony . . . . .	None.	13,700
<i>Syringa vulgaris</i> , or common Lilac . .	None.	160,000
<i>Tussilago Farfara</i> , or common Colt's-foot	1,200	12,500
<i>Vitis Vinifera</i> , or common Vine. . . .	None.	13,600

337. There is, it should appear, considerable analogy between the functions of many of the vegetable organs, and those of the animal body. The leaves, in particular, it has justly been remarked, seem to perform the office of the lungs, or respiratory organs. Both possess a system of conducting vessels; both are furnished with a cellular membrane, and a parenchyma, connected with air vessels, by which they communicate with the atmosphere, and are enabled to inhale oxygen, and exhale carbonic acid, and aqueous vapour. Finally, the leaves of plants, and the lungs of animals, laborate the vital fluid conveyed into their cells; and after effecting certain important changes, they return the prepared specific fluids, by another set of vessels, which are destined to convey them to other organs, whose function it is to distribute those nutritive fluids to the remotest parts of the vegetable or animal body.

I cannot close the present section in a manner more consistent with the unity of object, which I have ever kept in view, than by quoting at length, the letter referred to at No. 54 of the second section; after the perusal of which, the reader will be prepared to investigate the subject of the propulsion and distribution of the sap, and vegetable juices, by the agency of electric currents.

LETTER ON THE RELATION BETWEEN ELECTRICITY AND VEGETATION.

To the Editor of the New London Mechanics' Register.

“ Not being aware that the relation between electricity and vegetation has been treated of in the manner of which the following is an outline, I take the liberty of offering it for the consideration of your readers. The leading principles maintained are, that vegetation is continually extracting electric effluvium, from the atmosphere, which is constantly, though in degrees materially differing,

a state of positive electricity; that the structure of vegetables, and their juices, are adapted to act with the greatest efficacy in imbibing the effluvium; and that it is highly probable that they are indebted to its influence for their vitality. These conclusions are strongly favoured by the well-known discoveries which have been made of the constant positive electricity of the atmosphere; and that pointed conductors are peculiarly fitted for drawing off electricity in an easy and almost imperceptible manner. Vegetables abound in pointed terminations, communicating with juices passing through capillary tubes, and possessing strong conducting virtues; all of which circumstances must concur in adapting them for imbibing electric effluvium, and diffusing it through their substance. These facts, of the constant positive electricity of the atmosphere, and the adaptation of vegetables for imbibing it, seem necessarily, to lead to the inference, that they are continually acting in this manner upon the atmosphere. But the inference is strongly confirmed by applying *vegetable points* to the cylinder or prime conductor of an electrical machine. For, though it is only the juices of vegetation which possess conducting virtues, this circumstance concentrates the action of the electricity upon them; and its grasses, leaves, and other sharp and pointed extremities will be found to act with a peculiar activity in drawing off the effluvium. Few facts, indeed, are regarded as more fully established, than that metallic points are the most efficacious instruments in abstracting electricity. This conclusion can only be accounted for from the circumstance, that the attention of philosophers seems not to have been directed to the action of living points; for, on applying a blade of fresh grass, and a metallic point, either alternately, or in conjunction, to the electrized cylinder or conductor, it will appear that the grass acts at a greater distance, with more vigour than, and in preference to, the metal. The leaves of trees, and even their fine ramifications terminating in buds, and, in general, all the living pointed extremities, and the sharp and serrated edges of vegetation, will be found to possess the same energetic conducting qualities, in proportion to their vigour, and the acuteness of their termination. Even a thorn, or a thistle, will vie with, if not excel, the sharpest needle in this property; and it may be observed, that they are far better fitted to act upon the electricity of the atmosphere, as the deposition of moisture consequent to the withdrawing of the effluvium, which holds it in a state of vapour, so far from diminishing their conducting virtue, as in the case of metals, is the very principle of their nutrition; so that there is reason to conclude, that the action of every point furnishes it at once with the means of its vitality, and its growth and

maturation. *A few blades of grass held towards the knob of a charged jar, the circuit being completed by the human body, will silently, but quickly, effect its discharge, without sensibly affecting the human frame.* In short, every experiment upon the electric properties of the points and edges of vegetation, evinces their peculiar adaptation for imbibing electric effluvium, beyond that of any other known bodies; and, especially, that they are the only substances which are constituted for acting in a useful and necessary manner, both upon the electricity of the atmosphere, and upon the system of vegetation, of which they form a considerable and interesting part. This admirable adaptation of an atmosphere, constantly containing electric effluvium, to a system of vegetation, presenting strong conducting points at every extremity, in connexion with the capillary tubes, capable of imbibing and transmitting it through their juices, to every part of its substance, forcibly indicates their mutual utility and dependence. It constitutes a vast electrical apparatus, on which, in all probability, the existence of vegetation, and the ordinary tranquillity of nature depend. Storms and hurricanes sometimes occur even in the actual state of things; but if, instead of the myriads of active vegetable points extending to considerable heights, and acting with peculiar force near the earth's surface, no vegetation existed, and the electricity of the atmosphere continued to accumulate, the consequence might be expected to be nothing less than universal uproar and ruin!

“However new this representation may appear to many of your readers, or may be in reality, I do not see how, on comparing the several facts of which we are in possession, we can arrive at any very different conclusion. The subject certainly appears to me to open an extensive, and so far as I know, in a great measure, a new field of inquiry.”—“I beg to add, that, as the subject has occupied, and probably will continue to occupy, a considerable share of my attention, I propose to offer my views more at large to the philosophical part of the community, perhaps in a separate form, on some future occasion.

“The heads which have hitherto presented themselves to my mind are such as the following:—*The preparation of the atmosphere for exerting its electric influence, during the winter, for the approaching spring season.* Its influence in first awakening the dormant juices, and promoting the rise of the sap, and the commencement of the foliage and general spring of vegetation. Its subsequent effect in forwarding the general progress of vegetation, and the formation and ripening of its seeds and fruits, during the summer months; as also the manner in which it conduces to furnish oxygen out of the over-

flowings of its vigour, for the supply of animal respiration. And finally, its declining efficacy with the decline of vegetation in the autumn; and the manner in which a sufficient quantity of it is still preserved for the use both of animals and vegetables during the winter. With these, several other branches of inquiry are intimately connected; and I will just observe, that I strongly incline to the opinion, *that the phenomena of light, heat, electricity, and the expansion of bodies, are all reducible to the operations of one most subtle and universally diffused effluvium*: and that, while the respiration of animals extracts it from *oxygen gas*, by a chemical decomposition, it is furnished to vegetables out of that superabundance which floats in a loose, uncombined state in the atmosphere, or in that of positive electricity.”

“T. P.”

If the reader compare the subject of the foregoing letter—the passages noted in italics particularly—with what I have advanced on the sun’s electrizing influence at No. 66, on the food of plants at No. 103, and on the composition of the atmosphere at No. 141, and in some other preceding and following paragraphs, he will perhaps be inclined to view the causes and effects of electric agency in a manner somewhat different from that in which they have been explained by the advocates of the “*plus and minus*,” “positive and negative,” electrical conditions. When considering the subject of the precipitation of the *dew*, treated of in paragraphs 193 to 198, inclusive, it will probably appear, that electrical action is everywhere to be traced in coincidence with chemical developement; and that, in fact, storms and calms, the rise and fall of the barometer, and the mutations of the weather in general, are dependent, not so much on developed masses of electricity, as on electro-chemical divellent attractions, by which bodies are constantly inclined to form new combinations,—and during which, *specific electricities* that had previously held the original constituents in a state of quiescent union, are liberated, and rendered manifest in many of the grandest phenomena of nature.

Subsequently, this theory has, I conceive, acquired more than plausibility, from the masterly experiments detailed in the *New Researches in Electricity*, by Dr. Faraday.

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## SECTION II.

## PART I.

NATURAL HISTORY AND CULTIVATION OF ESCULENT  
VEGETABLES.

## ESCULENT ROOTS.

Subject 1. The TURNIP:—*Brassica Rapa*; *Cruciferae*. Class xv.  
*Tetradynamia*, of Linnæus.

338. *The Turnip* is a biennial, a native of Britain. It is a species of the genus *Brassica*; the essential generic character of which was described at the article *Brassica Oleracea*, No. 108. The specific character of the turnip, according to the last edition of the *English Flora*, is,—“*Root*, stem-like, fleshy, orbicular, depressed; *radical leaves*, lyrate, rough; those of the stem smooth, the uppermost entire.” The *flowers* are yellow, in numerous corymbose tufts; *calyx*, spreading in the upper part, though not at the base; *petals*, rounded; *pod*, cylindrical, veiny, smooth, with a tapering barren beak.—(*Idem.*)

339. *Varieties of the common Turnip, and estimate of sorts.*—The *Encyclopædia of Gardening*, at No. 3695, enumerates the following varieties, of which, those marked with an (\*) are the best for general culture.

- |                                  |   |
|----------------------------------|---|
| * Early white Dutch, or Stubble, | Green topped round white,                   |
| * Early stone,                   | Red topped ditto,                           |
| Common round white,              | Tankard large oblong,                       |
| Large round white,               | * French Navet ( <i>Br. napus</i> ),        |
| * Yellow Dutch,                  | Small round French ( <i>petit Berlin</i> ), |
| Aberdeen yellow,                 | * Norfolk white.                            |
| Maltese, golden,                 |   |

“The first three sorts are the fittest for early, first succession, and main summer crops for the table. The early white Dutch is proper both for the early and first succession crops, as is also the early stone. The Norfolk white is most eligible for the main crop; and the large round stands nearly on a par with that; and if not sown to come in with it, should at least succeed it as a late summer and autumn crop. The surest plant for winter consumption is the yellow Dutch; although constituted to stand intense frost unhurt, it has a fine flavour, and is very nutritive. The French, or *navet*, is of excellent flavour. It was anciently used throughout the south of Europe, and was more cultivated in this country a century ago than it is now.

It is grown in the sandy fields about Berlin, and also near Altona, from whence it is sometimes imported to the London market. Before the war, the queen of George III. had regular supplies from Mecklenburg."—(See *Encyc. of Gard.*, 3696.)

340. The *Swedish turnip* does not appear to belong to the species *rapa*. The *English Flora* says, "the Swedish turnip, not wild in Britain, is surely a distinct species (from *Br. rapa* and *Br. campestris*), as Mr. Knight has proved it to be from *Br. oleracea*." It is of a blueish sea-green, or a glaucous hue, is extensively cultivated in fields for sheep and other cattle, and is sometimes raised in gardens for winter consumption, like the yellow Dutch: in the spring, the young green shoots are much esteemed in many parts of the country.

341. *Soil and Situation*.—The soil should be light, sandy, and finely broken; it should never be manured with recent rank dung. Sir Humphry Davy says, "A small quantity of finely-divided matter is sufficient to fit a soil for the production of turnips; and I have seen a tolerable crop on a soil containing eleven parts out of twelve sand." The situation should be open, and fully exposed; and the field is better than the garden; for turnips, grown in the former—and the assertion holds good with respect to many other species of brassica, as well as to potatoes—are much better, and of finer flavour than when they are produced in a garden.

342. *Culture of the common Turnip*.—Abercrombie estimates the quantity of seed required, at half an ounce to every hundred square feet, if it be sown broad-cast; but turnips should be sown in drills, because the spaces can then be kept free from weeds, by the Dutch or thrust hoe.

Make small sowings every month, from the end of March to the last week in June: these are for early and successional supply. For the main crop, choose the field if possible, and sow in July, and, again, a smaller crop about mid-August. For the mode of sowing, see the *Cabbage*, 110. Begin with the early stone and Dutch; for the main crops, the larger sorts will be generally preferred; and for winter, the yellow Dutch is hardy, of easy culture, and of excellent flavour.

"As soon as the plants have rough leaves about an inch broad, hoe, and thin them to six or eight inches distance, cutting up all weeds. As the turnips increase in the root, a part may be drawn young, by progressive thinnings, so as to leave those designed to reach a full size, ultimately, ten or twelve inches asunder. Water garden turnips sometimes, in hot weather. One great advantage attending the cultivation of the *navet*, is, that it requires no manure whatever; and any soil that is poor and light, especially if sandy,

suits it, where it seldom exceeds the size of one's thumb or middle-finger; in rich manured earth it grows much larger, but is not so sweet or good in quality."—(*Justice and Dickson.*)

343. The *navet*, just named—the garden *navew*, or French turnip, is cultivated for its roots, which are served whole at table; but the wild *navew*, or *rape*, is an open colewort, with glaucous green leaves: it is cultivated in gardens for spring greens, the tops being first cut off as in the case of borecole; and then, the young side shoots. Many country people and cottagers take delight in this vegetable; it is a kind of staple in the gardens of Wiltshire and Somersetshire, for it supplies the family with greens, for six weeks or two months, in the early spring. The seeds should be sown in drills in July and August, for transplanting late in autumn.

344. The *Swedish turnip* is to be sown about the third or fourth week in April, in the same manner as the common turnip. When the young plants have attained an inch in height, thin them to two or three inches apart, and obliterate every weed. In July prepare to transplant into a piece of ground, which—Mr. Cobbett observes—should be manured with wood ashes, and not with dung. In a garden, where room is of consequence, set the young turnips in rows eighteen inches asunder, the plants a foot apart in the rows. Keep the beds free from weeds, and hoe the spaces deeply, two or three times. These turnips will not be very large; but if great, bulky roots be the object, transplant into an open piece of ground in a field, and let the rows be three feet asunder, and the plants sixteen or eighteen inches apart. Dig the spaces deeply two or three times, and suffer no weeds to remain. The Swedes will come into use in October and November; part may be housed for winter, and the remainder left for spring turnip-greens.

345. *Precautions against the Fly or Turnip-beetle.*—Sir Humphry Davy says that the Duke of Bedford, at his suggestion, caused a trial to be made at Woburn farm, of a mixture of lime and sulphur, strewed over some turnips in one part of a field; nothing was applied to the other part, but both were attacked nearly in the same manner by the fly. Mr. Knight informed Sir Humphry Davy, that, in consequence of his suggestion, he had tried lime slaked with urine, in mixture with three parts of soot; which composition was put into a small barrel, bored with gimblet-holes round it, so as to allow it to fall into the drills with the turnip seed. He says, "the adjoining rows were eaten away, and those to which the composition was applied were scarcely touched."—(*Agric. Chem.*, 202.)

Arch. Gorrie, a Scottish gardener, tried dusting the rows, when the plants were in the seed-leaf, with quick-lime, and found it effec-

tual. (See *Encyc. of Gard.*, Nos. 3701, 2, 3, 4, for other methods.) I think the best preventive, or one at least well deserving of a fair trial, would be prepared by carefully mixing four parts of perfectly burnt quick-lime, one part of flowers of sulphur and half a part of coal-soot, and sprinkled dry over the seeds at the time of sowing; also over the rows of young plants, just as they emerge from the earth; a quantity of ammoniacal gas is thus generated.

If the drills at any time be *partially* injured by the fly, stir the vacant spots of ground; water them, and sow the seed afresh. Keep the earth moist, and the young plants will soon fill up the blank spaces. In gardens, turnips frequently escape the fly altogether.

346. *Taking the crops, and preserving during winter.*—Draw the roots of early and succession sowings, as they attain a proper growth, with a view also to thin the rows, and promote the progress of those that remain. By this means a regular supply may be kept up during the greater part of the year; and towards the close of the autumn, before the frost sets in, take up the main crops, cut off the tops, and house the roots under a shed in a heap; covering it first with dry straw, and then with sand; or pack the turnips in chests, covering each layer with dry sand; thus protected, they will not become woolly, and will keep till March. Bulbous or tuberous roots are easily preserved, if light and moisture be wholly excluded.

347. *Turnip-tops* are obtained, either from the roots left in the ground all the winter, or by sowing the seed in September and October, for the express purpose; after running up for seed in the spring, the roots become fibrous and somewhat woody, and totally unfit for the table.

348. *Saving the seed.*—It is better to purchase than to grow the seed; for the seed-farmers have conveniences for preserving the plant free from admixture of sorts, which the domestic gardener does not possess. If, however, a few roots be left in the ground, or transplanted between November and February, apart from other plants of the same tribe, good seed may be obtained. Set the roots so deep as to be covered with soil; the flower stalks will be produced in the spring, and will ripen the seeds in August: tie them to stakes, to guard against the force of winds.

Subject 2. The RADISH:—*Raphanus Sativus*; *Cruciferae*. Class xv.  
*Tetradynamia*, of Linnæus.

349. The *Radish* is an annual, the essential generic character of which is, “a *pod*, tumid, imperfectly joined, without valves. *Seeds*, globular, the *Cotyledons* folded or incumbent.”—(*Eng. Flora*.)

The cultivated radish is a native of China, and is mentioned by

Gerrard in 1584. There are two distinct sorts of the radish: the one, spindle or tap-rooted; the other roundish and turnip-rooted: the former is termed by the French, *Rave*; the latter, they call *Radis*. Of these two sorts, there are many varieties, of which, the following are mentioned by Abercrombie:—

350. *Varieties and estimate of the Sorts.*

<i>Spindle, or tap-rooted.</i>	<i>Turnip-rooted.</i>
Early short-topped,	Small white turnip-rooted,
Deep red ditto,	Small red ditto,
Yellow ditto,	Large white ditto,
White ditto, new,	Black Spanish ditto.
Red long-topped,	
Salmon, or rose-coloured.	

“The best for general culture,” Abercrombie observes, “are the common taper-rooted radishes; and, chiefly, the *short-topped* varieties for the early and main crops; the salmon radish for successional and late crops: all of which are excellent for spring use, and early part of summer—from March till June—by repeated sowings from about Christmas till the latter end of May. As to the *turnip-rooted* radishes, the small white is a very delicate variety, sowed in February and March, to come in for use in April and May, or sowed in August for autumn use. Admit some of the small red turnip-rooted kinds to increase the diversity; but as to the large white and black turnip-rooted, they growing very large, are somewhat rank-tasted, though by many much admired, and are in perfection in autumn and winter, being sowed in July and August.”—(*Pocket Dict.—Raphanus.*)

351. *Culture of both sorts.*—The early short-topped and salmon among the spindle-rooted; and the small white and red among the turnip-rooted, may be sowed for succession crops every fortnight, from the latter end of February until the middle of May. The spindle-rooted varieties alone are cultivated for very early crops; and the market gardeners, who raise great quantities of early radishes, sow in December, or January, or earlier; and cover the beds with straw to the depth of several inches. I have experienced the benefit of this mode of culture; radishes which had been sown in the depth of winter, remained covered for some weeks during severe frost and much snow; when the weather became mild, the covering was removed, and the plants were found perfectly uninjured. The best method, however, to secure a crop of early short-top radishes, is to sow in a bed of light earth, under glass. November is the season, and, in the event of frost, the lights should be covered with double mats, or, what would be far better, with tarred boards, three quarters of an inch thick, and from twelve to fourteen inches broad.

It will generally be prudent to protect any newly-formed open beds with coverings of light branchy boughs, which may be kept in their places by heavier sticks placed across them. Birds delight in the seed of the radish, and their attacks must be prevented; the hedge-sparrow is very active in turning up fresh sown seeds, particularly those of mustard for salad; but branches of green furze prove an effectual protection.

Sow each sort separately, either broad-cast, or, which is much better, in shallow drills. The soil should be a free light loam, enriched with leaf-mould. "For a bed four feet six inches, by twelve feet, two ounces of seed will be required for the spring sorts; and an ounce and a half for the autumn varieties." The drills should be about six inches asunder, and they may be made very regular by adopting the following method:—Choose a light and mellow soil, not rankly manured. Dig it well, and make the earth fine. Stretch the line, and strike out the drill with the sharp angle of the hoe, half an inch deep. Lay a straight pole, like the handle of a hoe or a rake, and about six feet long, in this drill, and press it gently down with the foot; repeat the operation according to the length of the drill, and it will make the bottom smooth, of an equal depth throughout, giving, at the same time, a degree of solidity to the earth: scatter the seed equally, and not very close; draw earth over the seed of each drill, separately, or make all the drills first, then sow the seed; rake the bed, and press it level with the flat of the spade. The beds for radishes should not be more than four feet wide, with alleys between them and the next adjoining beds; let the drills be half an inch deep for the spindle-rooted kinds; and three quarters of an inch deep for the small turnip-rooted. Some recommend the drills to be traced much closer than six inches one from the other; but I have named that distance, to admit of hoeing, which cannot be readily effected when the plants grow almost close together. I now remark, what I omitted, when giving directions for the culture of carrot, parsnep, and beet-roots—that tap, or spindle-rooted plants, should not be deeply hoed. Hoeing excites those agencies which effect chemical fermentation, and thus causes the growth of lateral fibres from the tap-roots. Such roots are required to be of an even and perpendicular growth, and not to assume a forked or branchy shape. The Dutch hoe, cautiously applied, so as to raise the surface of the earth to the depth of half an inch, will kill the young weeds, without disturbing the ground, about the middle of the roots. Hand-weeding may be performed previous to the use of the hoe.

When the radish-plants show the seed-leaf, sprinkle a little soot or sulphuret of lime over them, along the drills; as soon as the

rough leaf is formed, thin the plants to two inches apart, and destroy weeds as fast as they appear.

352. *The large turnip radishes* require more space, for they grow to the size of a small turnip. Sow the seeds in July and August for autumnal and winter supply. The sowings should be performed in a manner similar to that mentioned for the smaller sorts; but the drills should be at least three quarters of an inch deep, and six or eight inches apart; the plants must be thinned as they advance, to the distance of six inches from each other. Water in dry weather.

353. *To save the seed*, it will be proper, in March, or early in April, to remove some fine, well-shaped roots, having compact and short tops; set them with the dibber, as deep as the leaves, which must not be cut off. Keep the different varieties remotely apart; and when the stems have attained the height of about eighteen inches, fasten them to sticks fixed firmly in the ground. These plants will ripen their seed in August and September.

*Radish pods for pickling* are obtained by leaving some plants in the original beds; by which means seed also can be procured, by cutting off every fine pod as it becomes ripe; if this precaution be not adopted, the seed will either be eaten by birds, or be scattered about and lost.

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#### CULTIVATION OF CELERY.

Subject 3. CELERY:—*Apium Graveolens*; *Umbelliferæ*. Class v.

Order ii. *Pentandria Digynia (Umbellatæ)* of Linnæus.

The essential generic character of the genus *Apium* is, according to the *English Flora*:—"Fruit, roundish ovate, with six acute dorsal ribs; interstices flat. *Calyx*, obsolete. *Petals*, roundish, with an inflexed point, very nearly equal. *Styles*, greatly swelled at the base. *Floral receptacle*, thin, orbicular, wavy. *Flowers*, nearly regular, united."

354. *The native wild Celery* is found in ditches and marshy ground, especially towards the sea-coast. It is biennial, and flowers in August and September; the flowers are small, numerous, greenish white; the apex of each petal inflexed, that is, bent inward, with a small curl towards the centre of the flower. "The seeds, and whole plants, in its native ditches, are acrid and dangerous, with a peculiar strong taste and smell. By culture it becomes the mild and grateful garden celery, for which, and its name, we are indebted to the Italians."—(SMITH'S *Flora*, Art. *Apium*.)

*Sweet apium, or celery*, has upright radical leaves, on long fleshy

foot-stalks, with the folioles five-lobed. Its varieties, according to Abercrombie, are :—

*Common Upright* hollow celery; foot-stalks of the leaves hollow: one variety is white, another red.

*Giant upright* celery; large.

*Upright solid* celery; having the foot-stalks of the leaves solid.

*Turnip-rooted* celery, or *celeriac*; with a large turnip-shaped root, and spreading leaves.

355. *Use*.—The leaf-stalks, when blanched, are used raw as a salad; they are in season from August, sometimes from July, to March, in the following year; they are used also to flavour soups, and sometimes are boiled as a dinner vegetable. Loudon says, “In Italy, the unblanched leaves are used in soups; and when neither the blanched nor the green leaves can be had, the seeds, bruised, form a good substitute. The root only, of the variety called *celeriac*, is used; and Sabine informs us (*Hort. Trans.*, vol. iii.), “It is excellent in soups, in which, whether white or brown, slices of it are used as ingredients, and readily impart their flavour. With the Germans it is also a common salad, for which, the roots are prepared by boiling, until a fork will pass easily through them; after they are boiled, and become cold, they are eaten with oil and vinegar. They are also sometimes served up at table, stewed with rich sauces. In all cases, before they are boiled, the root, and the fibres of the roots, which are very strong, are cut away; and the root is put in cold water, on the fire, not in water previously boiling.”—(*Encyc.* 3998.)

356. *Propagation*.—All the varieties are raised from seed, of which half an ounce is considered sufficient for a bed four feet and a half wide, by ten feet in length, for the upright sorts. I shall first describe the mode of culture recommended by Abercrombie, and then that practised by Judd, first premising that celery delights in a good rich soil, not manured with rank dung, but with vegetable compost; the ground should be deeply trenched, made light, free from stones, and then be well incorporated with the manure. As in its native state, it is found in moist places, it is very probable that, in the general mode of culture, celery does not receive one half of the water which it requires. I have not witnessed the practice of floating; but it would be well worth while to compare the results of two trenches in the same soil and aspect, one being floated to saturation during dry weather, the other treated in the ordinary manner. I would suggest that an ounce or two of common salt be dissolved in three gallons of soft water, and poured in the watered trench twice a week. It has been said above, that celery affects

spots near the sea; therefore salt may be useful to it. I employ salt continually in the garden, and I believe with good effect.

ABERCROMBIE'S METHOD OF CULTURE ABBREVIATED.

357. *Sowing*.—Celery is propagated by seed, sowed annually in the spring at two or three different times, to continue a regular succession from June, July, or August, till May, performing the first sowing early in March in a slender hot-bed, or warm sheltered border. Bury the seed very lightly, either by covering it with fine earth, or by raking it in moderately. A second sowing for the main crops may be made towards the end of March, or beginning of April, in an open bed, and a later sowing, about the end of April, or early in May. All the plants of each sowing are to be transplanted.

358. *Planting out*.—When the young plants attain the height of two or three inches, raise some of the best, and prick them out into nursery-beds to obtain strength. A few of the earliest may go into a moderate hot-bed, at two or three inches distance, to forward them, the others into the natural ground, in beds four feet wide, the rows six inches asunder, and the plants three inches apart in the rows. Give water, and let them grow about six weeks before final transplantation. Those remaining in the seed-bed will grow stronger and afford two or three drawings to prick out as above, or to plant at once into trenches.

359. *Removal into Trenches*.—As the plants advance from six to eight, or from ten to twelve inches high, they are to be transplanted into trenches, and the season for this work extends from June to October. Choose an open compartment of rich ground, clear it from weeds, mark out the trenches by the line and spade, a foot wide and three or more feet asunder. Dig out the cavity, making each trench a moderate spade's depth, laying the spits of earth alternately to the right and left on the wide spaces between, making it even; dig the bottom of the trenches lightly, and if the ground be poor, apply some rotten dung, and then dig the bottom. Then draw up a quantity of the stoutest plants, trim their straggling tops and long roots, and plant them by dibble in a single row along the middle of the bottom of each trench, four or five inches asunder; giving directly a good watering, and repeating it occasionally in dry weather, till the plants take root. Plant out successional crops every two or three weeks.

360. *Future Culture*.—The chief care required is to hoe up weeds, and earth up the plants by degrees, beginning the first earthings when the celery in the trenches has grown to the height

of eight or ten inches. With a hoe or spade, turn the earth lightly to each side of the rows of plants, about three or four inches high according to their size, and repeat the earthing with a spade every week, fortnight, or three weeks, as the celery advances in growth; using the earth that was thrown out of the trenches first, then that of the spaces between, till by degrees the plants are "landed" from twelve to twenty inches, or two feet high, according to the growth or variety, being careful, however, that the winter crops are landed well up near the tops in October and November.

361.—*Taking the Crop*.—Some of the earliest plants will be blanched a little, and fit to take up, by the middle or end of June and July; but the main crops will not be blanched till August, and will be in great perfection in September and October, continuing, in the succession crops, throughout the winter. The latest crops for spring use, planted out in September or October, &c., require but shallow trenches five or six inches deep. The ground for these crops may be previously dugged, and *drill* trenches formed with the line and hoe for the reception of the plants. (From the *Pocket Dictionary*, Art. *Apium*.)

#### JUDD'S METHOD OF CULTURE.

362. *Sowing*.—He sows about the middle of January, in a warm situation, on very rich ground, protecting it by mats at night. When the plants are from two to three inches high, he pricks out into a nursery-bed, immersing the plants as he draws them in water, so as they may remain moist while out of ground. The plants remain in the nursery-bed till they become "very strong."—(*Hort. Trans.*, vol. ii.)

363. *Transplanting*.—Judd prepares his ground for transplanting, by trenching it two spades deep, mixing with it in the operation, a good dressing of well-reduced dung from the old forcing beds. He says: "I give it a second trenching, that the dung may the better be incorporated with the mould, and then leave it in as rough a state as possible, till my plants are ready to put out. In the ground thus prepared, I form trenches twenty inches wide, and six inches deep, at six feet distance from each other, measuring from the centre of each trench. Before planting, I reduce the depth of the trenches to three inches, by digging in sufficient dung to fill them up so much. At the time of planting, if the weather be dry, the trenches are well watered in the morning, and the plants are put in, six inches apart in the row, in the evening, care being taken *by the mode* above-mentioned (362) to keep the fibres quite wet

whilst out of ground. As they are drawn from the nursery-bed, the plants are dressed for planting, and then laid regularly in the garden-pan. The trenches in which my rows of celery are planted being so very shallow, the roots of the plants grow nearly on a level with the surface of the ground: this I consider particularly advantageous; for as considerable cavities are necessarily formed on each side when the moulding takes place, all injury from stagnant water or excess of moisture is prevented. The trenches, when planted, are watered as may be required." He adds, "that he prepares his ground for celery during the winter, and avoids putting much of a crop in the space between the trenches, especially one that grows tall, as he finds celery does best when it grows as open as possible."

364. *Future culture*.—In "landing" or earthing up, Judd does "not think it well to load the plants with too much mould at first; the two first mouldings therefore are done very sparingly, and only with the common draw-hoe, forming a ridge on each side of the row, and leaving the plants in a hollow to receive the full benefit of the rain and waterings. When the plants are strong enough to bear six inches height of mould, the moulding is done with the spade, taking care to leave basis enough to support the mass of mould which will ultimately be used in the ridge, and still keeping for some time the plants in a hollow, as before directed. The process of moulding is continued through the autumn, gradually diminishing the breadth of the top, until at last it is drawn to as sharp a ridge as possible, to stand the winter. In the operation of moulding, it is necessary, in order to prevent the mould from falling into the heart of the plant, to keep the outer leaves as close together as possible; for this purpose, before I begin the moulding, I take long strands of bass matting, tied together till of sufficient length to answer for an entire row, and I fasten this string to the first plant in the row, then pass it to the next plant, giving it one twist round the leaves, and so on, till I reach the other end, where it is again fastened; when the moulding is finished, the string is easily unravelled by beginning to untwist it at the end where it was last fastened."—(*Encyc. of Gard.*, 4006, &c.)

365. *General Remarks*.—Little need be added to directions so ample and judicious; there are, however, a few minutiae to be attended to.

(1.) As celery seed lies long in the ground, and is very tardy in its early growth, it will sometimes be advisable to make use of artificial heat for the earliest crop. The hot-bed need not be made up of dung alone,—tree-leaves, mixed with it, or with mowings of grass or nettles, are excellent substitutes. It may be constructed in any

sheltered spot of ground, three feet wide, four feet long, and two feet high. Place four broad boards on the sides of the base, in order to preserve the square form of the bed, or lay a close lining of long littery manure on each of the sides. Cover the surface with a stratum of fine rich earth, six inches in depth; place upon it a common open frame, made by nailing four boards together,—and when the heat rises gently, but regularly, sow the seed evenly, and not thickly over the bed; then sift over it a quarter of an inch of light soil. At night, protect by double mats, and thus a fortnight or more may be gained.

Some, as fine plants as I ever saw, grew on my asparagus bed,—and from self-sown seed. A stray celery plant having seeded near the bed—a few seeds had fallen; and, as I conjecture, had been scattered by the wind over its surface. Be this as it may, the means of sowing were unknown at the time, but the results in the following spring, were a set of clean, well-grown celery plants, which went at once into trenches, without any intermediate nursing.

I mention the fact, not by any means to recommend the practice of sowing on asparagus beds, but as a hint, that if a spot of well-protected, yet open ground, were prepared in the autumn, and the surface, after being smoothed and levelled, were sown moderately close in November, covered first with a quarter or half an inch of sifted soil, and then with littery manure, to the depth of four inches, a crop of fine plants might be anticipated early in the spring. It would, as in the case of asparagus, be requisite to rake off the litter as soon as the frosts appear to have finally ameliorated; and it must always be deemed an indispensable proviso, that the seed be sown so late in the season, as to leave no chance of its germinating before the frost sets in. Under ground the seed would be as secure as in a drawer; but if the plant should rise above the surface, the first hint of a frost would cause the destruction of the whole. When the young plants emerge, they should be protected by a covering of mats placed over hoops.

(2.) To secure success in the trenches, the ground ought to be extensively manured. Gardeners are apt to confine the enrichment merely to the bottoms of the trenches; the consequence is, that when the roots extend beyond six or eight inches on each side, they run into ground far less abundant in decomposable nutritive matters; Judd's method of previous preparation is, therefore, highly to be commended.

(3.) Skill is required to perform the trenching in a workman-like manner. In order to begin the work well, the ground should *be trodden to a pretty firm state*; then two lines are to be strained

very tight along the space to be trenched out, at the required distances apart—say, of from twelve to eighteen inches. The spade is to be placed close by one of the lines, with its back inwards, and pressed perpendicularly down, if the ground be of a binding quality, or with a slight inclination outwards, if it be of a light, crumbling nature. The spade is to be thrust as deep as it will go, and if, on withdrawing it, it do not come up clear from earth, the edges of the trench will be ragged; therefore, to obviate this, it will be advisable to dip the spade in a pail of water before pressing it down. Thus proceeding along one line, and then returning by the other, the ground will be marked out, and will “lift” without much trouble, leaving the sides even, or so nearly even, that they may be readily finished off.

A correct eye and a little practice will lead to dexterity and precision—and celery trenches, when neatly formed, are very sightly, and do credit to the gardener. I do not say that trenches are ever indispensable—for I have grown excellent celery in mere drill-trenches, made by the line with a draw-hoe; there is, however, I think, more trouble in earthing up, when the plants are so near the surface.

(4.) At the time of planting out, either into nursery beds, or trenches, all the little offsets or suckers that emerge from the collar of the root should be stripped off.

(5.) I object to trimming the tops of the leaves—a practice which is usually recommended at the period of final removal, on the ground “that the old leaves always die and decay.” They may die, it is true, if much violence be used in pulling up the plants, but the amputation of the leaflets will not by any means prevent their death. I assert, however, that the leaves may be preserved, if the plants be carefully eased out of the beds by a trowel, and immediately placed in water, as practised by Judd; and if they are of real utility in vegetation, the excision of one single leaf, is the loss of an important and vital organ. A row of nicely-trimmed plants presents, I grant, a neater appearance for a few days, but there the advantage ceases—for the untrimmed plant will stand erect and be growing, by the time that the putrescence of the shortened foot-stalks is in full progress; in the former, the proper juice will be elaborated and duly distributed, while, in the latter, new parts must be developed, before the principles of growth and strength can come into active operation.

(6.) In *earthing up*, a dry day, and a dry state of the upper soil, should be preferred. The edges of the trench are to be first cut by the spade, an inch at a time, with the utmost nicety—the soil will

fall into the trench, but is not to be drawn to the plants till they have been secured by tying. I prefer a soft-twisted string for this work, because, by measuring the length of the trench, and allowing about three inches for the turn that is to be taken round each plant, a string of the proper length, without a single knot in it, can easily be prepared—and this is an advantage, as it obviates the inconvenience resulting from the knots in the *bass line* employed by Judd. I also tie one end of the string to a small stick, and thrust the stick into the soil, a little beyond one of the plants, at either end of the trench; this secures the plants, keeps them firm and upright, and does not permit the string to come off; the work is finished by tying the line to another stick at the opposite end of the trench. If no string or bass be used, the leaves and stalks of each plant must be held together by the left hand, while the earth is brought round it with a hand-hoe, or garden trowel.

In the subsequent earthings up, particularly when the plants become tall, a pair of long strips of inch boards may be placed, one on each side of the leaves, as high as the earth is to be carried up; to be secured in their situation, by two pointed sticks, thrust into the soil at each end: the strips will be pressed firmly against the leaves, and keep them in a proper position. One man may thus ridge-up a row of plants with great precision; but this work is always better performed by two men. The strips should be kept ready for the purpose: they may be from twelve to fourteen feet long.

366. *Protection during Winter.*—Frost and snow, generally speaking, will not do much injury; but alternations of frost, sunshine, and rain, will cause the plants to decay at the heart; therefore it is always prudent, previous to the approach of settled frost, to arch over the trenches with hoops, and cover them with mats; or, what is better, to fix two boards in the form of a ridge or roof, so that the rain may shoot off the two sides. Whatever covering is used during settled frost, it must not be removed till the ground become perfectly tractable under the spade. A dozen or two of the finest plants ought always to be taken up, before the setting in of a frost, and preserved in dry sand, in a cellar, or warm shed—for it is impossible to dig up celery, when the ground is hard frozen, without doing much injury to the blanched leaf-stalks. In the severe season of 1838, the rows of celery were destroyed, almost to a plant; this indicates precaution.

#### CULTURE OF CELERIAC, OR TURNIP-ROOTED CELERY.

367. *According to Abercrombie,*—It is propagated by seed, sowed in March or April, in beds of common earth, for transplantation,

thinning the young plants to three inches—and when four or five high, plant them out in a plot of digged ground, in drills drawn by a hoe, three or four inches deep, by two feet asunder, in which, set the plants in a row, six inches apart, and water them.

Then, when they are advanced in growth, and the root swelling, earth them up once or twice, four or five inches high, which will improve the roots, render them white, tender, and fit for use in three or four weeks after being earthed.—(*Pocket Dict.—Apium.*)

According to Sabine:—"The times of sowing are the same as for the other sorts. Celeriac requires a rich soil, and the plants are raised on a hot-bed under glass, and transplanted when two or three inches high, to another hot-bed, and set one inch and a half apart. In the beginning or middle of June, they are transplanted into a flat bed in the open air, at the distance of fifteen inches from each other, and not in trenches, like other celery. They must be abundantly watered as soon as they are set out, and the watering must be repeated every other day, or if the weather should be warm, every day. As they increase in size, they will require a greater quantity of water, and they must be occasionally hoed; the roots will be fit for use 'in September or October.' In a note to this paper, Sabine states, that he has been informed, that the plan of giving excess of water is peculiar, and that the vigorous growth of the plant is more dependent on richness of soil than on other causes."—(*Encyc. of Gard.*, 4017—from *Hort. Transactions*, iii.)

Celeriac seed, when purchased, cannot at all times be trusted. Until 1831, when a friend gave me a packet, procured at Boulogne, under the title *celeri-rare*, I never obtained celeriac. This seed was sown in a shallow drill, (though a hot-bed would have been better,) and the young plants were removed to nursery rows, richly manured. They retained every appearance of celery, till their final removal; when, being planted fifteen inches asunder, the leaves took a horizontal direction, without elongating.

The roots are in season according to the treatment they receive, from September, till January; they are rough, knobby processes, covered with fibres. I did not perceive that excess of watering was required.

368. *To save celery Seed.*—Select one or two fine plants, conveniently situated, and leave them to go to flower and ripen their seeds. Sometimes the plants will require the support of a stake, if they be exposed to the influence of winds. The seed, when perfectly ripened, will retain its vegetative power for three or more years; it should be kept very dry, however: it is highly aromatic.

## PART II.

### OPERATIONS IN THE VEGETABLE GARDEN, FOR THE MONTH OF JULY.

369. *Sow*,—in the first week, broccoli seed, for late spring supply.

Kidney-beans (32); endive,—and again, in the third week.

Small salading three times if required; and lettuce, in a shady spot.

Peas, the frame, Charlton and Knight's (27), and again towards the close of the month.

Beans, mazagan, and white blossom (24), for late crops.

Cabbage for coleworts (114), once or twice.

Turnips (342) at any time during the month.

Turnip radish, the black and largo white (352).

*Transplant*,—cabbage (110), savoy (116), broccoli (124), some into nursery beds, and others, according to their growth, into final plantations.

Celery (358) early in the month, from seed beds into others of rich earth, four inches apart; and water regularly. Set out large grown plants (363) in trenches for blanching.

Lettuces,—Cos, Sillesia, and others, from the seed-beds.

*Attend* to the onion beds, and bend down the stems of those that begin to turn colour; take up ripe onions, shallots, and garlic, and expose them to the sun on a dry spot of ground.

Lay the vines of cucumber plants in straight and regular order = dig lightly round, but not too near their roots.

*Gather* herbs for drying—mint, balm, sage, &c.; dry them in the shade. Stick peas, top beans, and scarlet runners; earth up the rows of beans, peas, potatoes, &c. Hoe frequently; remove weeds and litter; and water small crops and plants that have recently been transplanted.

## SECTION III.

## PART I.

## NATURAL HISTORY AND CULTIVATION OF THE BLACK MULBERRY.

*Morus Nigra*; *Urticeæ*. Class xxi. Order iv. *Monoecia Tetrandria*, of Linnæus.

370. The Black Mulberry produces male and female flowers apart, on the same tree. The male blossoms are in an *amentum*, or catkin; the females, in a roundish head. The *calyx*, after flowering, becomes coloured and juicy; is converted into a succulent eatable berry, each tubercle, or calycine seed-vessel, enclosing a small seed, the whole congeries forming the mulberry. The *male* flowers have a four-parted calyx, which, in the *female*, is four-leaved with two styles; *corolla*, none.

“The black mulberry is a native of Persia, and it is supposed was brought into Europe by the Romans, as Pliny mentions two varieties. It will not live in the open air in several parts of Sweden, and is treated as a wall-tree in the north of Germany. It is mentioned by Tusser, in 1573, and was cultivated by Gerrard in 1596. Forsyth mentions ‘four large mulberry-tees as still standing on the site of an old kitchen-garden, now part of the pleasure-ground at Sion House, which the late Duke of Northumberland used to say were about three hundred years old.’ The mulberry-tree is remarkable for putting out its leaves late; so that when they appear, which is generally in May, with the leaves of the common ash-tree, the gardener may take it for granted that all danger from frost is over.” (*Encyc. of Gard.*, 4596.)

The frost which occurred in the morning of the 7th of May, 1831, attacked the young shoots of the mulberry. The previously fine and genial month had stimulated this generally tardy tree; and in many places the young shoots that had advanced to the length of three or four inches were entirely cut off.

The mulberry-tree is also susceptible of serious injury from the winter frost. The tree above alluded to, had made fine progress during six years subsequent to 1831. By the frost of January, 1838,

(2° — zero) its buds became paralyzed, they enlarged a little, but were not developed in the middle of June.

371. *Propagation*.—M'Phael, on the culture of this tree, says but little; he observes, "The plants are raised from layers or cuttings put into the earth in autumn or spring. The mulberry is a tree rather slow in growth, but it lives to a great age, and spreads its branches widely. It prospers well in deep sandy earth. Its fruit ripens in England towards the latter end of August, or in September. After it comes into a bearing state, all the pruning that it requires is to cut out any branches that happen to die, or become unproductive, and to keep its shoots from being crowded." (*Remem.* 142.)

372. *The mulberry-tree is propagated by layers* of the young shoots, either of young trees formerly headed down to the bottom, to form stools to furnish lower shoots near the earth for laying, or of the lower branches of trees not headed; having pots of earth elevated on stands nearly up to the branches, and laying the shoots therein. They will be well rooted in autumn, after one summer, and should then be planted in a nursery, where they are to be trained to a single stem, unless designed to be formed into espalier or wall trees. In four years, they will be fit for final removal to the places where they are to remain. Wood of any age will do, but it is likely that the young shoots proceeding from wood of two or three years' growth, would most speedily produce vigorous trees, provided a narrow ring of bark were taken off the older wood, and each branch were then passed into the side, or through the hole of a flower-pot properly elevated. The pot being filled with sandy loam,—the surface of which should be two inches above the annular incision, would soon be filled with roots, and the plant being severed from the parent, the young tree, as in the case of the vine, might be turned out of the pot with the ball entire, without receiving injury in the removal.

373. *By Cuttings*.—"Miller says, mulberry cuttings will strike well if planted in a hot-bed in spring. Knight failed in thus raising cuttings, but was very successful by the following process. He cut vigorous shoots from the trees in November, and formed them into cuttings of about five inches long, each consisting of about two parts of two years' old wood, and one part of yearling wood. They were intended to be put in pots, and the bottom of each cutting was cut so much aslope, that its surface might be nearly parallel with the of the bottom of the pot in which it was to be placed. The cuttings were then placed in the common ground, under a south wall, and so deeply immersed in it, that one bud only remained visible

above its surface; and in this situation they remained till April. At this period the buds were much swollen, and the upper ends of the cuttings appeared similar to those of branches which had been shortened in the preceding autumn, and become incapable of transmitting any portion of the ascending fluid. The bark of the lower ends had also begun to emit those processes which usually precede the production of roots. The cuttings were now removed to the pots, to which they had been previously fitted, and placed in a moderate hot-bed, a single bud only of each cutting remaining visible above the mould, and that being partially covered; and in this situation they vegetated with so much vigour, and emitted roots so abundantly, that I do not think one cutting in a hundred would fail with proper attention. The mould I employed was the alluvial and somewhat sandy loam of a meadow, which was sparingly supplied with water; and the plants, till they had become sufficiently rooted, were shaded during bright weather.' "

It is now understood that the mulberry, like many varieties of the apple, may be propagated with great facility by large cuttings—the recorded fact, that at Bruce Castle, near Tottenham, Middlesex, an immense branch being torn off by the wind from an old mulberry-tree, many years since, that the branch was thrust into the ground and flourished, *and is now a handsome tree*, is a corroborative evidence, that, "A cutting from a tree which has borne fruit, will soon become a vigorous plant."

374. *By Grafting*.—"Knight having planted some young mulberry trees in pots, raised them to the bearing branches of old trees, and grafted them by approach. The grafts bore fruit the third year, and continued annually productive. The tree succeeds very ill by the common mode of independent grafting."—(*Hort. Trans.* i. 60.)

375. *Situation*.—Forsyth and others recommend planting mulberry trees in orchards and pleasure grounds, that they may have grass beneath them to receive the ripe fruit which falls from the tree. Abercrombie says: "so nice is the criterion of perfect ripeness, that berries falling without damage, are superior to those gathered." Williams, on the contrary, contends against planting the trees in such a situation: "the standard mulberry receives great injury by being planted on grass-plots with the view of preserving the fruit when it falls spontaneously. No tree perhaps receives more benefit from the spade and the dunghill than the mulberry; it ought therefore to be frequently dug about the roots, and occasionally assisted with manure. The ground under the tree should

be kept free from weeds throughout the summer, particularly when the fruit is ripening, as the reflected light and heat from the bare surface of the soil is thus increased; more especially if the end branches are kept pruned, so as not to bower over too near to, and shade the ground. The fruit is also very fine if the tree is trained as an espalier, within the reflection of a south wall or other building. If a wooden trellis were constructed, with the same inclination as the roof of a forcing-house, fronting the south, and raised about six feet from the ground, leaving the soil with the same inclination as the trellis, a tree trained on it would receive the solar influence to great advantage, and would probably ripen its fruit much better than a standard."—(*Hort. Trans.* ii. 92.)

376. *Mode of bearing, and pruning.*—The mulberry produces its fruit on the young yearling shoots from wood of the preceding year, as well as on spurs of the two-year-old wood. Miller and Forsyth agree with M'Phael, that little pruning is necessary for standard trees, further than to remove cross and irregular branches. Abercrombie says: "Permit the trees to branch out freely every way; they require no pruning, except just to reform any casual, low straggler, or very irregular or crowding branch. Some also may be trained as dwarfs, for wall and espalier trees, with short stems, half a foot or more high, and the branches trained in a fan manner to the wall or espalier, six inches asunder, and mostly at full length without shortening. Give them a summer and winter pruning; train in occasional supplies of young, and retrench worn-out bearers, &c., as directed for peaches: they will produce larger fruit, ripening a little before the standards."

*Morus nigra*, the black mulberry, is found in all the Catalogues, but I find no mention of varieties. It is certain, however, that such must exist, for the fruit of some trees is large, full of juice, and of a flavour altogether rich and bland; whereas, other trees yield a very diminutive fruit, possessing little juice or flavour, and of a pithy and yielding texture. Mulberry-trees fetch a high price; therefore, purchasers ought to be very particular in their inquiries, and to be certain of the respectability of the nurseryman, before they pay seven shillings and sixpence, or perhaps ten shillings, for a tree which may never yield a single berry equal in flavour to that of the common bramble.

377. *Pruning and training wall and espalier trees.*—Knight observes, that, "in cold situations (and it is chiefly in such that the mulberry-tree will be found to deserve a place on the south wall) little fruit will be produced, and that will ripen but ill, unless the bearing wood be brought closely against the wall; and the ground

width of the leaves, and vigorous habit of the tree, present some difficulties to the cultivator when this mode of pruning and training is adopted. It will be found necessary to diminish the luxuriant growth of the tree, and at the same time to increase its disposition to bear fruit. Such effect may, however, be readily produced by several means: by destroying a small portion of the bark, in a line extending round the trunk or large branches, or ringing; by tight and long-continued ligatures, or by training the bearing branches almost perpendicularly downwards. I have adopted the last mentioned method, because it greatly increases the disposition of the tree to bear fruit, without injuring its general health, and because it occasions a proper degree of vigour to be everywhere almost equally distributed. As the blossom-buds of the mulberry-tree cannot be readily distinguished from others in the winter, the best period for pruning is when the blossoms first become visible in the spring. Pinch off every barren shoot which is not wanted to cover the wall, and stop every bearing shoot under similar circumstances, at the third or fourth leaf. Williams has correctly stated, that the bud immediately below the point at which a bearing or other branch is pinched off, usually affords fruit in the following year. (KNIGHT, in *Hort. Trans.* iii. 63.) The mulberry-tree succeeds better than any other tree when trained downwards, either horizontally and drooping, or in the stellate manner; that is, with a tall stem, the branches being trained as a star, or like the point of a mariner's compass, pointing all round in a circle.

Forsyth, Miller, and Knight agree, that old trees may be renovated by heading down completely, and renewing the soil by richly manured earth. (See *Encyc. of Gard.*, Art. *Mulberry*.) Soil and site have certainly much influence on these trees, and will, perhaps, occasion a marked difference in the fruit.

## PART II.

### OPERATIONS IN THE FRUIT DEPARTMENT.

378. Attend to the work of pruning, and regulating the wall and espalier trees; also to the routine culture mentioned in the operations of the last month.

*Budding* may now be commenced, if the bark will separate freely.

*Plant* strawberries in beds or borders; the young plants, and

those which still show flower, or are coming to fruit, should occasionally be very well watered. March is the best month for planting new beds.

#### MISCELLANEOUS.

379. *Sow* a few annuals for succession; and plant cuttings of sweet-williams, pinks, rockets; pipings of pinks and carnations. Divide the roots of auriculas, polyanthuses, and the primulas.

*Transplant* late sown annuals; also hollyhocks, lychnises, sweet-williams, wall-flowers, pinks, peonies, and many other herbaceous plants; introduce the bee ophrys, and pyramidal orchis.

*Clip* box-edgings; mow grass lawns, very early in the morning, if the weather be dry; at any hour, if showery.

*Gather*, and preserve seeds as they ripen; cut flowers with a knife or scissors, so as not to disfigure the plants; and attend to every operation consistent with neatness or good order.

380. *Selection* of a few of the many shrubs and plants that flower in the month of July.

*Deciduous Shrubs*.—Roses of many kinds; *Rosæ*; *Azaleas*, *Fuchsia*, five or six sorts; St. John's-wort, *Hypericum*, two or three sorts.

*Eevergreen Shrubs*.—Yellow rock-rose, or cistus, *Cistus helianthemum*; horse-shoe geranium, *Pelargonium zonale*, &c.; Heath, *Ericæ*; broad-leaved kalmia, *Kalmia latifolia rubra et alba*; rose-bay, *Rhododendron*, two or three species; trailing gaultheria, *G. procumbens*.

*Herbaceous Plants*.—Musk-Mallow, *Malva Moschata*; sweet-pea, *Lathyrus odorata*; hollyhocks, *Alcea*; love-lies-bleeding, and prince's feather, *Amaranthus caudatus et hypochondriacus*; musk scabious, *Scabiosa atro purpurea*; cardinal flower, *Lobelia cardinalis, et fulgens*. Dahlia, some of the earliest.

*Bulbous-rooted*.—White martagon and tiger lily, *Lilium candidam, chalcedonium et tigrinum*; pyramidal orchys, *Orchis pyramidalis*; bee ophrys, *Ophrys apifera*.

## THE NATURALISTS' CALENDAR.

## JULY.

THIS is generally the hottest month of the year; and one of the two or three months that are altogether free from frost; the thermometer has in three or four instances, within the last twelve years, risen to  $85^{\circ}$ ,  $87^{\circ}$ , and once even to  $90^{\circ}$ ; and though it is a remark that such hot weather usually "breaks up with a thunder storm," thunder was then less frequent than in wet and windy seasons, when atmospheric decompositions, developpe of necessity, masses of electricity, which often induce the phenomena of thunder and lightning. July is frequently a showery month: the rain, towards the middle of it, assumes somewhat of a periodical character; and hence, doubtless, the continuation of the popular superstition, which ascribes to St. Swithin the long continued rains that in some years do so much injury to the crops. "If it rains on St. Swithin's day, there will be rain the next forty days." The tradition, some say, took its origin from the following circumstance: "Swithin, or Swithum, Bishop of Winchester, who died in 868, desired that he might be buried in the open church-yard, and not in the chancel of the minster, as was usual with other bishops, and his request was complied with; but the monks, on his being canonized, considering it disgraceful for the saint to lie in a public cemetery, resolved to remove his body into the choir, which was to have been done with solemn procession on the 15th of July; it rained however so violently for forty days together at this season, that the design was abandoned."—(FORSTER'S *Perennial Cal.*, from HOWARD'S *Climate of London.*)

The 15th of July *now*, does not coincide with the 15th of the olden time, before the change of the style: how is it that the saint's influence has not been somewhat interfered with by that alteration? We can only reply, that Saints are different from other men; and that their prerogatives are not to be shuffled off by Acts of Parliament!

The average height of the barometer is about 29 inches 86 cts.

Ditto

thermometer, about 64 degrees.

*Second week.*—The quail (*Perdix coturnus*, vel *Tetrao fagineus*) calls, or utters its three singular notes during day, through great part of the night.

*Third and Fourth week.*—The great horse-fly (*Tabanus borealis*) appears; young partridges (*Perdix cinerea*) fly; domestic fowls begin to moult.

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## A U G U S T.

## SECTION I.

## SCIENCE OF GARDENING.

## VEGETABLE PHYSIOLOGY.

## PART III.

## PHENOMENA OF VEGETABLE LIFE.

381. *Nature of vegetable life.*—Before we attempt to investigate the phenomena of the vegetable developments, it will be proper to make some inquiry into the nature of vegetable life itself; and the question immediately suggests itself,—whether that life be essentially such as is usually understood by the term *vegetative*—that is, entirely devoid of volition, sensation, and spontaneous motion; or whether plants, to a greater or less extent, be not endowed with the qualities, in common with other living organized beings. The inquiry is one of great interest, and therefore, it will be requisite to have recourse to some of our most accredited authorities, from whose works I shall have occasion to quote largely, because it is essential that nothing be omitted, that can tend to throw light upon a subject involving much intricacy, and which, in itself, is so sublime, as to have induced the late Sir J. E. Smith to close the first chapter of his *Introduction* in the following impressive manner:—  
 “I humbly conceive that if the human understanding can, in any case, flatter itself with obtaining in the natural world, a glimpse of the immediate agency of the Deity, it is in the contemplation of this vital principle, which seems independent of material organization, and an impulse of his own divine energy.”

Keith observes, on the authority of Humboldt, that, “the best and most satisfactory evidence of the presence and agency of a vital principle, as inherent in any subject, is perhaps that of its rendering the subject, in which it inheres, capable of counteracting the laws of chemical affinity. The rule is applicable to the case of vegetables,

as is proved by the intromission, digestion and assimilation of the food necessary to their development; all indicating the agency of a principle capable of counteracting the laws of chemical affinity."

Dr. Smith, when comparing vegetable and animal organization, remarks that—"Vegetables are organized beings, supported by air and food, endowed with life, and subject to death, as well as animals. They have, in some instances, spontaneous, though we know not that they have voluntary motion. They are sensible to the action of nourishment, air and light, and either thrive or languish, according to the wholesome or hurtful application of these stimulants. This is evident to all who have ever seen a plant growing in a climate, soil, or situation, not suitable to it." "The spontaneous movements of plants are almost as readily to be observed, as their living principle." (See *Light*, no. 180.) "As they possess life, irritability, and motion, spontaneously directing their organs to what is natural and beneficial to them, and flourishing according to their success in satisfying their wants, may not the exercise of their vital functions be attended with some degree of sensation, however low, and some consequent share of happiness? Such a supposition accords with all the best ideas we can form of the Divine Creator; nor could the consequent uneasiness which plants must suffer, no doubt in a very low degree likewise, from the depredations of animals, bear any comparison with their enjoyment on the whole. However this may be, the want of sensation is most certainly not to be proved with regard to vegetables, and therefore of no use as a practical means of distinguishing them, in doubtful cases, from animals." (p. 3, 4.) "The most satisfactory remark I have for a long time met with, is that of M. Mirbel, in his *Traité d'Anatomie et de Physiologie Végétales*. He observes, Vol. i. p. 19, 'that plants alone have a power of deriving nourishment, though not indeed exclusively, from inorganic matter, mere earths, salts, or airs, substances certainly incapable of serving as food for any animals, the latter only feeding on what is or has been, organized matter, either of a vegetable or animal nature. So that it should seem to be the office of vegetable life alone, to transform dead matter into organized living beings.' This idea appears to me so just, that I have in vain sought for any exception to it." (p. 5.)

"If it be asked, what is this vital principle, so essential to animals and vegetables, but of which fossils are destitute, we must own our complete ignorance. We know it, as we know its Omnipotent Author, by its effects.

"Perhaps in the fossil kingdom, heat may be equivalent to a vital

principle; but heat is not the vital principle of organized bodies, though, probably, a consequence of that principle. Living bodies of animals and plants produce heat; and the phenomenon has not, I think, been entirely explained on any chemical principles, though, in fossils, the production of heat is, in most cases, tolerably well accounted for.

“In animals it seems to have the closest possible connexion with the vital energy; but the effects of this vital energy are still more stupendous in the operations constantly going on in every organized body, from our own elaborate frame to the humble moss or fungus.” (p. 7.)

I venture to dissent from the opinion of this excellent man, that if vegetables be endued with sensations, their enjoyments, upon the whole, abundantly counterbalance the sufferings they experience from depredations of various kinds; for, not to say anything of the ravages of animals which feed upon herbage, if we consider the arts and inventions by which man is enabled to bring the vegetable creation under his absolute control; if we take into the account the operations of amputation, deracination, cutting, pruning, ringing, and the variety of instruments whereby these operations are effected, where is the mind of sensibility, believing plants to be endued with sensation, that would not revolt from the daily and hourly infliction of torture upon the most innocent and beautiful of the Creator's work, and turn with disgust from those horticultural pursuits, which might otherwise constitute one of its most gratifying sources of enjoyment?

It surely appears more consistent with benevolence and philosophic truth, to look upon plants as organized beings, endued with a species of life, wholly dependent upon electrical currents; and so constituted, as to be the chief intermedia between the surface of the earth, and the atmosphere which surrounds it; and by whose instrumentality, chemical changes of the highest order are effected, among the most important of which may be ranked, the attraction of aqueous vapours, and the condensation of the dew. (No. 198).

382. *Progress of vegetation.*—The structure of the seed has been described somewhat at large in paragraph 254. “The *matter* of the seed,” observes Sir Humphry Davy, “when examined in its common state, appears dead and inert; it exhibits neither the forms nor the functions of life. But let it be acted upon by moisture, heat, and air, and its organized powers are soon distinctly developed. The cotyledons expand, the membranes burst; the radicle acquires new matter, descends into the soil, and the plume rises towards the free air. By degrees the organs of nourishment of dicotyledonous

plants become vascular, and are converted into seed leaves, and the perfect plant appears above the soil. Nature has provided the elements of germination on every part of the surface; water, and pure air, and heat are universally active, and the means for the preservation and multiplication of life, are at once simple and grand." (*Agric. Chemistry*.) When a matured seed, therefore, has been deposited in the ground, at such a depth as to exclude light, (though this is not always an indispensable condition,) and yet to admit of the access of air and of moisture, the vital functions, stimulated by electro-chemical agency are excited, and germination commences. The young root or radicle, *a*, (Fig. 18, 1,) first appears, and is sent downwards in search of nourishment, as well as to fix the plant to the ground. The next step in the vegetative process, is the expansion and bursting of the cotyledons, or seed-lobes, *o o*; and to this

Fig. 18.



follows the advance of the plumule, or embryo, *p*. The expanding embryo resembles, in some degree, a little feather, and has, for that reason, been named by Linnæus, *plumula*; it soon becomes a tuft of young leaves, with which the stem, if there be any, ascends. In the garden bean, exhibited at No. 1, the cotyledons do not emerge from the soil; but in the dwarf kidney-bean,—in the radish, No. 2

and in all the subjects of the Brassica tribe, as well as in many other plants, the cotyledons ascend, and form the leaves first developed, styled the seed leaves. Thus, *ff*, represent these seed leaves of the radish, which, when enclosed in the husk, or *testa* of the dry seed, constituted the two cotyledons: *g*, is the radicle, now become a fusiform spindle, or tap root (see 242—*c*); *h*, is the tuft of leaves and young stem rising between the seed leaves.

388. *The chemical phenomena of germination*, “consist chiefly in the changes that are effected in the nutriment destined for the support and developement of the embryo till it is converted into a plant. This nutriment either passes through the cotyledons, or is contained in them; because the embryo dies when they are prematurely cut off. But the farinaceous substance of the cotyledons, at least in exalbuminous seeds, is a proof that they themselves contain the nutriment. They are regarded, therefore, as the repositories of the food destined for the support of the embryo in its germinating state. And if the seed is furnished with a distinct and separate albumen,” (see 254—3,) “then is the albumen to be regarded as the repository of food, and the cotyledons as its channel of conveyance. But the food thus contained in the albumen or cotyledons, is not yet fitted for the immediate nourishment of the embryo. Some previous preparation is necessary; some change must be effected in its properties: and this change is effected by the intervention of chemical agency. The moisture imbibed by a seed placed in the earth, is immediately absorbed by the cotyledons, or albumen, which it readily penetrates, and on which it immediately begins to operate a chemical change, dissolving part of their farina, or mixing with their oily particles, and forming an emulsive juice. The consequence of this change is a slight degree of fermentation, induced, perhaps, by the mixture of the starch and gluten of the cotyledons in the water, which they have absorbed, and indicated by the extrication of a quantity of carbonic acid gas, as well as by the smell and taste of the seed. This is the commencement of the process of germination, which takes place even though no oxygen gas be present; but if no oxygen gas be present, then the process stops; which shows that the agency of oxygen gas is indispensable to germination. Accordingly, when oxygen gas is present, it is gradually inhaled by the seed; and the farina of the cotyledons is found to have changed its savour. Sometimes it becomes acid, but generally sweet, resembling the taste of sugar: consequently is converted into sugar, or some substance analogous to it. This is a further proof that a degree of fermentation has been induced; because the result is precisely the same in the process of malting called the saccharine

fermentation, in which oxygen gas is absorbed, heat and carbonic acid evolved, and a tendency to germination indicated by the shooting of the radicle. The effect of oxygen, therefore, in the process, is that of converting the farina of the albumen, or cotyledons, into a mild saccharine food, fit for the nourishment of the infant plant, by diminishing the proportion of its *carbon*, and in augmenting, by consequence, that of its oxygen and hydrogen."

If the foregoing almost literal, but abbreviated, quotation, from KEITH's *Third Section*, book iv., and from No. 724 of the *Encyclopædia of Gardening*, be compared with that from the *Agricultural Lectures*, given at No. 382, and with what now follows from the same work of Sir Humphry Davy, the reader will be enabled to form a pretty correct idea of the opinions entertained by modern philosophers, concerning the exciting causes of incipient vegetation.

384. *Agency of Oxygen*.—"Seeds are incapable of germinating, except when oxygen is present. In the exhausted receiver of the air-pump, in pure azote, in pure carbonic acid, when moistened, they swell, but do not vegetate; and, if kept in these gases, lose their living powers, and undergo putrefaction. If a seed be examined before germination, it will be found more or less insipid, at least not sweet; but after the germination it is always sweet. Its coagulated mucilage, or starch, is converted into sugar in the process; a substance difficult of solution is changed into one easily soluble; and the sugar carried through the cells or vessels of the cotyledons, is the nourishment of the infant plant."

"In the production of a plant from a seed, some reservoir of nourishment is needed before the root can supply sap; and this reservoir is the cotyledon, in which it is stored up in an insoluble form, and protected, if necessary, during the winter, and rendered soluble by agents which are constantly present on the surface. The change of starch into sugar, connected with the absorption of oxygen, may be rather compared to a process of fermentation than to that of respiration; it is a change effected upon unorganized matter, and can be artificially imitated; and in most of the chemical changes that occur when vegetable compounds are exposed to air, oxygen is absorbed, and carbonic acid formed or evolved."

"It is evident that in all cases of tillage, the seeds should be sown so as to be fully exposed to the influence of the air. And one cause of the unproductiveness of cold, clayey, adhesive soils is, that the seed is coated with matter impermeable to air.

"In sandy soils the earth is always sufficiently penetrable by the atmosphere. Any seed, not fully supplied with air, always pro-

duces a weak and diseased plant. The process of malting is merely a process in which germination is artificially produced, and in which the starch of the cotyledon is changed into sugar; which sugar is afterwards, by fermentation, converted into spirit."—(*Agric. Chem. Lect. 5.*)

It appears from what has been quoted, that philosophers believe the developement of the plantlet, and its subsequent nourishment, to be effected by the agency of oxygen upon one or more of the constituents of the seed,—chiefly the *carbon*, the results of which are the production of a saccharine, nutritive substance, and the formation of carbonic acid, both of which are fitted to become the food of the plant, when taken up, by intossusception, into its absorbent vessels. But what, it may be asked, is the primary exciting agent;—from whence is this oxygen produced, which effects such surprising changes? In paragraph 103—c, I have endeavoured to show, that the chemical union of the constituents of water, and of vegetable substances, being disturbed by divellent attraction, oxygen and other gases are evolved, and electricity developed\*. This electricity not only induces the formation of fresh compounds, but propels the nutritive matters into the vessels of the roots. To this it may be added, that air and water, fluids which are indispensable to the primary excitement of the vital functions,—are essentially the same in their constituent elements, (see 141,) that is to say, both the one and the other are composed solely of hydrogen and oxygen; but these elements are united in different proportions, and their union is maintained by peculiar and specific electric attractions. Hence, it results, that fluids of very different gravities and densities are produced. *Seeds* are composed chiefly of the elements of oxygen, hydrogen, and carbon; substances which appear to be identical with the elements of water, or to be produced from it; for, it is certain, that plants which occasionally grow in, and are supported by water alone, such as hyacinths in glasses, and mustard and cress, when grown upon flannel, moistened by water alone,

\* It may be doubted, by some, whether electricity is in reality developed; but upon what ground can this be questioned? If every process of decomposition be effected by electric agency, the view of the subject will, I think, be much simplified. Every substance in nature is a compound substance; its constituents are held together by some mysterious cement; that cement I conceive to be light—the grand vivifyer—the supporter, if not the prime agent, of the vital principle; all matter is replete with it, and in definite, specific, and determinate proportions. When this is disturbed, decompositions are effected, and, as in the ordinary chemical processes, without the revealment of any electric current, which, therefore, passes and combines invisibly.

furnish carbon in great abundance\*. The incipient processes of vegetation seem then to depend upon a species of fermentation, produced by the play of affinities between the elements of water, when combined under different forms, in bodies possessing different densities; and this play of affinities is probably brought about by the inductive influence of the sun's rays,—the primary agent, and grand first natural cause of all electrical developements. This inductive influence produces disturbance among the components of the various bodies when they come into contact;—new arrangements are then formed, and *heat* is developed, in consequence of the union of specific electricities so set at liberty. Having thus premised that the incipient processes of vegetation are to be traced to the influence of the solar rays upon compound bodies, the constituents of which are held together by electro-chemical attraction, and that the heat which results is invariably a consequence or effect, and not a primary cause of the decomposition of such bodies, I shall now proceed in my quotations of authorities on the process of vegetable nutrition.

385. “*Plants are nourished in a manner in some degree analogous to the animal economy.*—The food of plants, whether lodged in the soil, or wafted through the atmosphere, is taken up by introsusception in the form of gases or other fluids; it is then known as their sap; this sap ascends to their leaves, where it is elaborated as the blood of animals is in the lungs.”

“*Introsusception.*”—(See 103—c.) “As plants have no organ analogous to the mouth of animals, they are enabled to take up the nourishment necessary to their support only by absorption, or inhalation, as the chyle into the animal lacteals, or the air into the lungs. The former term is applied to the introsusception of non-elastic fluids” (liquids), “the latter to that of gaseous fluids. The absorption of non-elastic fluids by the epidermis of plants, does not admit of a doubt†. It is proved, indisputably, that the leaves not only contain air, but do actually inhale it. It was the opinion of Priestley that they inhale it chiefly by the upper surface; and it has been shown by Saussure that their inhaling power depends entirely upon the organization. Fruits will not ripen, and roots will not thrive, if wholly deprived of air; and hence it is probable that they inhale it by their epidermis, although the pores by which it enters should not be visible‡. In the root, indeed, it may possibly enter in com-

\* See SAUSSURE'S *Experiments*—KEITH'S *Phy. Bot.*, Vol. II. 49.

† See *Functions of the Epidermis*, No. 242, and No. 321.

‡ A very interesting article appears in *Les Annales de Chemie, &c.*, No. 46, Feb., 1831, on the maturation of fruits, by M. Couverchel.

bination with the moisture of the soil; but in the other parts of the plant, it enters, no doubt, in the state of gas. Herbs, therefore, and the soft parts of woody plants, absorb moisture, and inhale gases, from the soil or atmosphere, by means of the pores of their epidermis, and thus the plant effects the introsusception of its food." (*Encyc. of Gard.*, 739, 740, from KEITH, Vol. II., c. 3.)

386. *Ascent of the sap.*—"The means by which the plant effects the introsusception of its food, is chiefly that of absorption by the root. But the fluids existing in the soil, when absorbed by the root, are designated by the appellation of sap or lymph; which, before it can be rendered subservient to the purposes of vegetable nutrition, must either be intermediately conveyed to some viscus proper to give it elaboration, or immediately distributed throughout the whole body of the plant. The sap is in motion, in one direction or other, if not all the year, at least at occasional periods, as the bleeding of the plants in spring and autumn sufficiently illustrates. The plant always bleeds most freely about the time of the opening of the bud, for, in proportion as the leaves expand, the sap flows less copiously, and when they are fully expanded, it entirely ceases. But this suspension is only temporary, for the plant may be made to bleed again in the end of autumn, at least, under certain conditions. If an incision is now made into the body of the tree, after a short but sharp frost, when the heat of the sun, or mildness of the air, begins to produce a thaw, the sap will flow again. It will also flow even when the tree has been but partially thawed, which sometimes happens on the south side of a tree, when the heat of the sun is strong and the wind northerly. At the seasons now specified, therefore, the sap is evidently in motion; but the plant will not bleed at any other season of the year."—(*Idem*, 741, from KEITH, Vol. II., page 102, 3.)

387. *Conducting vessels.*—In order to convey, in as few words as possible, a distinct idea of the theories advocated by some of our most celebrated phytologists, and with a view to introduce Knight's theory of vegetation, and Dutrochet's electrical hypothesis, it will be requisite to quote from Dr. SMITH's *Introduction to Botany*. That author observes in his eighth chapter, that, "the great difficulty has been to ascertain the vessels in which the sap runs. Two of the most distinguished inquirers into the subject, Malpighi and Grew, believed the woody fibres, which make so large a part of the vegetable body, and give it consistence and strength, to be the sap-vessels, analogous to the blood-vessels of animals, and their opinion was adopted by Du Hamel. In support of this theory, it was justly observed that these fibres are very numerous and

strong, running longitudinally, often situated with great uniformity, (an argument for their great importance,) and found in all parts of a plant, although in some they are so delicate as to be scarcely discernible. But philosophers sought in vain for any perforation, anything like a tubular structure, in the woody fibres, to countenance this hypothesis, for they are divisible almost without end, like the muscular fibre. This difficulty was overlooked, because of the necessity of believing the existence of sap-vessels somewhere; for it is evident that the nutrimental fluids of a plant must be carried with force towards certain parts, and in certain directions, and that this can be accomplished by regular vessels only; not, as Tournefort supposed, by capillary attraction through a simple spongy or cottony substance."

The opinions alluded to in the foregoing extract, prevailed about the latter end of the seventeenth and the beginning of the eighteenth century; for Malpighi, an Italian physician, was elected fellow of the Royal Society of London, in 1669, and he died in 1694; Dr. Grew, a member also of the same society, died in 1711; Tournefort, a French philosopher and botanist, published his *Elémens de Botanique* in 1694, and died in 1708; and Du Hamel, also a French philosopher, died in 1782. Dr. Smith observes, that he himself received the first hint of what he believed to be the true sap-vessels, from the Second Section of Dr. DARWIN'S *Phytologia*, a work which was published in 1801; wherein, "it is suggested that what have been taken for *tracheæ*—air-vessels or wind-pipes—are really absorbents, destined to nourish the plant, or, in other words, sap-vessels. The same idea has been adopted, confirmed by experiments, and carried to much greater perfection by Mr. Knight\*, whose papers in the *Philosophical Transactions*, for 1801, 1804, and 1805, throw the most brilliant light upon it, and, I think, establish no less than an entirely new theory of vegetation, by which the real use and functions of the principal organs of plants are now, for the first time, satisfactorily explained. In a young branch of a tree or shrub, or in the stem of an herbaceous plant, are found, ranged round the centre, or pith, a number of longitudinal tubes, or vessels, of a much more firm texture than the adjacent parts, and, when examined minutely, these vessels often appear to be constructed with a *spiral coat*. Malpighi asserts that these vessels are always found to contain air only, and no other fluid; while Grew reports that he sometimes met with a quantity of moisture in them; both judged

\* It cannot be doubted that Dr. Smith mistook Mr. Knight's papers:—see *Note to No. 388*.

them to be air-vessels. Dr. Darwin suggested their real nature and use. He is, perhaps, too decisive when he asserts that none of them are air-vessels, because they exist in the root, which is not exposed to the atmosphere. We know that air acts upon the plant under ground, because seeds will not vegetate in earth under the exhausted receiver of an air-pump. (*Phil. Trans.*, No. 23.) I do not, however, mean to contend that any of these spiral-vessels are air-vessels, nor do I see reason to believe that plants have any system of longitudinal air-vessels at all, though they must be presumed to abound in such as are transverse or horizontal. Dr. Darwin and Mr. Knight have, by the most simple and satisfactory experiments, proved these spiral-vessels to be the channel through which the sap is conveyed. The former placed leafy twigs of a common fig-tree about an inch deep in a decoction of madder, and others in one of log-wood. After some hours, on cutting the branches across, the coloured liquors were found to have ascended into each branch by these vessels, which exhibited a circle of red dots round the pith, surrounded by an external circle of vessels containing the white milky juice, or secreted fluid, so remarkable in the fig-tree.”—(SMITH'S *Introduction*, Ch. 8.)

388. *Mr. Knight's Theory.*—“ Mr. Knight, in a similar manner, inserted the lower ends of some cuttings of the apple-tree and horse-chesnut into an infusion of the skins of a very black grape in water, an excellent liquor for the purpose. The result was similar. But Mr. Knight pursued his observations much further than Dr. Darwin had done; for he traced the coloured liquid even into the leaves, ‘but it had neither coloured the bark, nor the sap between it and the wood; and the *medulla* was not affected, or, at most, was very slightly tinged.’ (*Phil. Trans.*, 1801, p. 335.) The result of all Mr. Knight's experiments and remarks seems to be, that the fluids destined to nourish a plant, being absorbed by the root and become sap, are carried into the leaves by these vessels, called by him *central vessels*, from their situation near the pith. A particular set of them, appropriated to each leaf, branches off, a few inches below the leaf to which they belong, from the main channels that pass along the *alburnum*, (see No. 311, fig. 12,) and extend from the fibres of the root to the extremity of each annual shoot of the plant. As they approach the leaf to which they are destined, the central vessels become more numerous, or subdivided. ‘To these vessels,’ says Mr. Knight, ‘*the spiral tubes are everywhere appendages.*’ By this expression, and by a passage in the following page\*, 377, this writer

\* “The whole of the fluid, which passes from the wood to the leaf, seems to me

might seem to consider the spiral line, which forms the coats of these vessels, as itself, a pervious tube; or else that he was speaking of other tubes with a spiral coat, companions of the sap-vessels; but the plate which accompanies his dissertation, and the perspicuous mode in which he treats the subject throughout, prevent our mistaking him on the last point."—(*Idem.*)

It is evident that there is something confused, if not contradictory, in the foregoing description of Mr. Knight's theory; for if that gentleman believed the spiral vessels to be the true conductors of the sap, how happens it that he asserts "the spiral tubes will neither carry coloured fluids, nor in the smallest degree retard the withering of the leaf, when the *central vessels* are divided? Which are these central vessels? Are they not the large punctuated or reticulated tubes, (311—313,) those vessels, the texture of which is membranous and tubular throughout, to which the spirals are appendages; that is, with which they are in close, or juxta position, or round which they wrap, or are folded in a continuous spiral coil? The dissection of the vascular bundles is a process of extreme delicacy, and even of difficulty, but I think I have observed appearances which justify the belief that the spirals are generally accessaries to the sap-vessels, and not themselves the main conducts of the sap: what their chief functions are, and what the modes in which they may aid the vital currents, I have endeavoured to point out, (or rather to hint at, in order to excite investigation,) at No. 332 of the first section for July. With a few to elucidate further the theory of Mr. Knight, I extract the following passages from the *Encyclopædia of Gardening*.

389. *What are the channels of the sap?*—"There are simple tubes, porous tubes, spiral tubes, mixed tubes, and interrupted tubes: through which of these does the sap ascend? The best reply to this inquiry has been furnished by Knight and Mirbel. Knight prepared some annual shoots of the apple and horse-chesnut, by means of circular incisions, so as to leave detached rings of bark with insulated leaves remaining on the stem. He then placed them in coloured infusions, obtained, by macerating the skins of very black grapes in water; and, on examining the transverse section at the end of the experiment, it was found that the infusion had ascended by the wood, beyond his incisions, and also into the insulated leaves, but had not coloured the pith nor bark, nor the sap between the bark and wood. From the above experiment, Knight concludes that the sap ascends through what are called the common tubes of the

evidently to be conveyed through a single kind of vessel; for the spiral tubes will neither carry coloured infusions, nor in the smallest degree retard the withering of the leaf when the central vessels are divided."—Note by Mr. Knight.

wood and alburnum, at least till it reaches the leaves: thus the sap is conveyed to the summit of the alburnum. But Knight's next object was to trace the vessels by which it was conveyed into the leaf: the apple tree and horse-chesnut were still the subjects of experiment. In the former, the leaves are attached to the plant by three strong fibres, or rather bundles of tubes, one in the middle of each leaf-stalk, and one on each side. In the latter, they are attached by several such bundles. Now, the coloured fluid was found, in each case, to have passed through the centre of the several bundles, and through the centre only, tinging the tubes throughout almost the whole length of the leaf-stalk. In tracing their direction from the leaf-stalk upwards, they were found to extend to the extremity of the leaves; and in tracing their direction from the leaf-stalk downwards, they were found to penetrate the bark and the alburnum, the tubes of which they join, descending obliquely till they reach the pith, which they surround. From their position, Knight calls them *central tubes*, thus distinguishing them from the common tubes of the wood and alburnum, and from the *spiral tubes* with which they were everywhere accompanied as *appendages*, as well as from a set of other tubes which surrounded them, but were not coloured, and which he designates by the appellation of external tubes. The experiment was now transferred to the flower-stalk and fruit-stalk, which was done by placing branches of the apple, pear, and vine, furnished with flowers not yet expanded, in a decoction of log-wood. The central vessels were rendered apparent as in the leaf-stalk. When the leaf of the former was fully formed, the experiment was then made upon the fruit-stalk, in which the central vessels were detected as before; but the colouring matter was found to have penetrated into the fruit also, diverging round the core, approaching again in the eye of the fruit, and terminating at last in the stamens. It was by means of a prolongation of the central vessels, which did not however appear to be accompanied by the spiral tubes beyond the fruit-stalk. Such then are the parts of the plant through which the sap ascends, and the vessels by which it is conveyed. Entering by the pores of the epidermis, it is received into the longitudinal vessels of the root, by which it is conducted to the collar. Thence it is conveyed, by the longitudinal vessels of the alburnum, to the base of the leaf-stalk and peduncle; from whence it is further transmitted to the extremity of the leaves, flower, and fruit. There remains a question to be asked, intimately connected with the sap's ascent. Do the vessels, conducting the sap, communicate with one another by inosculation," (from *in* and *osculatio*—from *os-oris*, the mouth, a junction of one vessel with another by the orifices or mouths,) "or otherwise, as

that a portion of their contents may be conveyed in a lateral direction, and consequently, to any part of the plant; or do they form distinct channels throughout the whole of their extent, having no sort of communication with any other set of tubes, or with one another? Each of the two opinions implied in the question has had its advocates and defenders. But Du Hamel and Knight have shown that a branch will still continue to live, though the tubes leading directly to it are cut in the trunk; from which it follows that the sap, though flowing the most copiously in the direct line of ascent, is, at the same time, also diffused in a transverse direction." (*Encyc.* 746,—from KEITH, Vol. II. 115.)

Keith further observes, that it is to be regretted that Mr. Knight's description of the central vessels is not altogether so explicit as it could be wished. To which, he asks, of M. Mirbel's tubular tissue of large tubes, small tubes, simple tubes, porous tubes, spiral tubes, and mixed tubes, (see No. 297,) do the central vessels correspond? If we regard their respective functions, they can correspond only to the small tubes, as by them alone, according to M. Mirbel, the sap ascends. After all, "the function of the spiral tubes is as much involved in obscurity, as ever. Grew, who, with Malpighi, regarded them originally as being destined to transmit air, is known to have retracted his opinion, or at least to have modified it, so that he regarded them as being also sap-vessels, and even as the sole sap-vessels of the alburnum. But this opinion is evidently contradicted by the fact that no tracheæ are to be found in the wood or alburnum, except in the annual shoot immediately surrounding the pith; for they are not generated in the succeeding and annual layers, by which the stem and trunk are augmented in width; and they are obliterated by age in the vicinity even of the pith itself.

"It is, indeed, the opinion of Knight, that they are altogether incapable of transmitting moisture; but this can refer only to their uncoiled state (see fig. 19), in which they do not form a tube, but merely a loosely spiral line: for in the coiled up state in which they exist in the living vegetable, and in which the spires are united, they form a perfect tube, which we cannot regard as incapable of transmitting moisture, without some proof." On the contrary, Hedwig affirms, that in *Cucurbita Pepo* and *Momordica Elaterium*, in which the spirals are large, the juices may be seen issuing from their orifices, if the section be inspected immediately after the stem is divided.

Such are Keith's remarks, (Vol. II., p. 119—121). I myself

have certainly observed interrupted masses, or links, as it were, of fluid, closely resembling the bubble and liquid in the tubular spirit-level of a theodolite; the vessels were ringed transversely, but whether they were spiral or punctuated tubes, no microscopic power that I applied was capable to determine.

390. *Causes of the ascent of the sap.*—After an attentive comparison of the facts adduced in the two preceding numbers, little doubt can remain that by the term *central tubes*,—those which conduct coloured infusions,—Mr. Knight does not mean to convey the idea, that the spiral vessels are the real and regular conductors of the sap; nor does dissection, I think, warrant any other conclusion than that the sap-vessels are (though not without exceptions) those hollow membranous tubes to which the spirals are adjuncts or accessaries. Coloured fluids do certainly ascend through a portion of the vegetable vessels, but produce no effect on the greater part of the vegetable structure. If cuttings of the young shoots of the vine, apple, currant, elder, sage, and of many other plants, be placed for some hours in a decoction of log-wood or Brazil wood, they exhibit, when cut *across* above the part immersed, circles, or detached masses of brownish red dots; but the cellular membrane surrounding these dots, the pith, and the bark, exhibited no traces of this colouring matter.

If *longitudinal* cuttings be examined, the course of the tubes may often be ascertained by the effects of the coloured infusions; but so minute is each individual vessel of a bundle, composed, probably, of from fifty to a hundred tubes, that the precise structure can scarcely be determined. In fact, the subject is one on which the most contradictory opinions prevail; and viewing it in this light, the author of *The Treatise on Vegetable Physiology*, observes, that, while the subject of the functions of the vessels remains undecided, “the following hypothesis may be hazarded:—That the spiral vessels are intended for conveying upwards the sap in *young plants and shoots*, and that they accomplish this with a very moderate impulse, owing to the easy contraction of the fibre, lessening the diameter of successive portions of the vessel, and thus raising the sap, forced into it, by an impulse, communicated in the radical fibrils: but that, as in the more advanced age of the plant, the strength of the coats of the radical fibril increases, no contracting power in the coats of the vessels becomes requisite, and all that is necessary, is a sufficient strength of the coats of the vessels to resist the pressure of the ascending fluid, which receives its impulse in the roots, and ascends as it were, through dead tubes. The nature of this impulse, and the effect which it produces on the progress of the

sap, (for there is no *circulation* of that fluid,) will be fully explained in the *Treatise on the Functions of Plants*," (p. 8.) It happens, unfortunately, that although this passage was published in November, 1827, about twenty months have since elapsed, without producing that most desirable *Treatise* on the vegetable functions.

The late Mr. Knight, in one of his invaluable letters, assured me, that he had seen ample reason to retract his opinion concerning the *central* vessels, which he formerly considered as the direct conduits of the sap. He discovered that, it is through vessels *cellular* in structure, and not through the *tubes* of the alburnum, that the sap ascends. By the most minute and accurate observations and experiments, Mr. Knight, in conjunction with his friend M. Dutrochet, arrived at this conclusion, and also that the spirals *conduct* no fluid whatever, unless it be *air*. In fact, when we carefully examine the tubes commonly considered as such; and compare their dry, fibrous texture, with the juicy, membranous condition and structure of the *cells* of the alburnum and bark, I can scarcely hesitate to subscribe my cordial acquiescence with the opinions of these two eminent physiologists. I may add that, the *endosmosis*, or active permeability of *membrane*—so ably demonstrated by M. Dutrochet and Dr. Mitchell, of America—tends very powerfully to support the hypothesis, that the sap of plants and trees ascends through the cells of the alburnum; and that the *spirals* and other *tubes*, (though they may at times, contain fluids,) should be regarded as *mechanical agents* of support, elasticity and motion, rather than as vehicles of conduction.

391. *The opinions entertained by philosophers of different periods*, concerning the sap's ascent, may be collected from the following abbreviated quotations, chiefly from KEITH'S *Physiological Botany*. Some supposed that in the spring, great quantities of moisture are absorbed by trees from the atmosphere, and hence the source of the abundance of sap; others ascribed its ascent to capillary attraction, or that power by which fluids ascend in tubes of extremely fine or hair-like perforations; and that the permanence of the action of this power depended upon the evaporation from the leaves. On the supposition that the cuticle of plants was vascular, and, as in the instances of trees and shrubs, possessing external orifices, some reasoned that "in the early part of spring, the gentle heat expands the mouth of these vessels, before contracted by the winter's cold. Into these orifices, the external air rushes and presses down to the roots. To these it gives energy, as it does to the moving fibres of animals; and by its pressure it may assist in propelling the *juices* upwards. An additional quantity of air is evolved by the

internal motions of plants, and the whole passes off with the perspirable matter. In this way, there seems to be a circulation of air through plants, assisting, and assisted by, the powers which move the juices. On this account, trees overgrown with moss, have few leaves, weak shoots, and no fruit.”—(See “*Botany*,” *London Encyc.*, p. 235.)

Grew ascribes the ascent to two causes; “the volatile nature of the sap, and *magnetic* tendency, aided by the agency of fermentation.” These expressions are somewhat dark and involved, but they indicate that the philosopher, of whom Dr. Smith observes, “it was the character of this excellent man to observe every thing without reference to any theory, and his book is a storehouse of facts relating to vegetation,”—that this observant philosopher had received impressions from facts which led his mind to conclude that plants were operated upon by agencies which, had the science of modern chemistry been then understood by him, he would have considered as identical with those of electro-chemical attraction and decomposition.

“Malpighi was of opinion that the sap ascends by means of the contraction and dilatation of the air contained in the air-vessels. M. de la Hire,” a French mathematician, who died in April, 1718, “attempted to account for the phenomenon, by combining together the theories of Grew and Malpighi; and Borelli,” a Neapolitan professor of philosophy and mathematics at Florence and Pisa, afterwards made by Christina, the ex-queen of Sweden, then at Rome, a member of her academy of learned men, and who died in 1769, “endeavoured to render their theory more perfect, by bringing to its aid the influence of the condensation and rarefaction of the air and juices of the plant.

392. *Agency of Heat*.—Du Hamel endeavoured to account for the phenomenon from the agency of heat, and chiefly on the following grounds—because the sap begins to flow more copiously as the warmth of spring returns; because the sap is sometimes found to flow on the south side of a tree, before it flows on the north side; because plants may be made to vegetate, even in winter, by means of forcing them in a hot-house; and because plants raised in a hot-house produce their fruit earlier than such as vegetate in the open air. There can be no doubt of the great utility of heat in forwarding the progress of vegetation; but it will not therefore follow, that the motion and ascent of the sap are to be attributed to its agency. On the contrary, it is well known that if the temperature exceeds a certain degree, it becomes then prejudicial both to the ascent of the sap, and also to the growth of the plant.

“Hales”—(Dr. Stephen Hales, author of *Vegetable Statics*, and *Vegetable Essays*, who died in January, 1761)—“found that the sap flows less rapidly at mid-day, than in the morning; and every body knows that vegetation is less luxuriant at midsummer than in the spring. There are many plants, such as the arbutus, laurustinus, and the mosses, that will continue not only to vegetate, but to protrude their blossoms, and mature their fruit, even in the midst of winter; so that although heat does, no doubt, facilitate the ascent of the sap by its tendency to make the vessels expand, yet it cannot be regarded as the efficient cause, since the sap is proved to be in motion, even throughout the whole of the winter. Du Hamel endeavours, however, to strengthen the operation of heat by means of the influence of humidity, as being powerful in promoting the ascent of the sap, whether as relative to the season of the year, or time of the day. The influence of the humidity of the atmosphere cannot be conceived to operate as a propelling cause, though it may easily be conceived to operate as affording a facility to the ascent of the sap in one way or other; which, under certain circumstances, is capable of most extraordinary acceleration, *but particularly in that state of the atmosphere which forebodes or precedes a storm*. In such a state, a stalk of wheat was observed by Du Hamel to grow three inches in three days; a stalk of barley, six inches, and a shoot of vine, almost two feet; but this is a state that occurs but seldom, and cannot be of much service in the general propulsion of the sap. On this important subject, Linnæus appears to have embraced the opinion of Du Hamel, or an opinion very nearly allied to it; but does not seem to have strengthened it by any new accession of argument; so that none of the hitherto alleged causes can be regarded as adequate to the production of the effect.”—(*Encyc. of Gardening*, from KEITH, Vol. II. 125, &c.)

393. *Saussure's theory of irritability*.—“Perhaps the only cause that has ever been suggested as at all adequate to the production of the effect is that alleged by Saussure. According to him, the cause of the sap's ascent is to be found in a peculiar species of irritability inherent in the sap-vessels themselves, and dependent upon vegetable life; in consequence of which they are rendered capable of a certain degree of contraction, according as the internal surface is affected by the application of stimuli, as well as of subsequent dilatation, according as the action of the stimulus subsides; thus admitting and propelling the sap by alternate dilatation and contraction. In order to give elucidation to the subject, let the tube be supposed to consist of an infinite number of hollow cylinders, united one to another; and let the sap be supposed to enter the first cylinder, by

suction, or by capillary attraction, or by any other adequate means; then the first cylinder being excited by the stimulus of the sap, begins gradually to contract, and to propel the contained fluid into the cylinder above it. But the cylinder above it, when acted on in the same manner, is affected in the same manner; and thus the fluid is propelled from cylinder to cylinder, till it reaches the summit of the plant. So also, when the first cylinder has discharged its contents into the second, and is no longer acted upon by the sap, it begins again to be dilated to its original capacity, and prepared for the intro-susception of a new portion of fluid. Thus a supply is constantly kept up, and the sap continues to flow.”—(*Idem*, 131\*.)

394. *Mr. Knight's theory of contraction and dilatation.*—“Knight has presented us with a theory, which, whatever may be its real value, merits at least our particular notice as coming from an author who stands deservedly high in the list of phytological writers. This theory rests upon the principle of the contraction and dilatation, not of the sap-vessels themselves, as in the theory of Saussare, but of what Knight denominates the *silver grain*, assisted, perhaps, by heat and humidity expanding or condensing the fluids.”

On this subject of the silver grain, Sir Humphry Davy observes:—“In the arrangement of the fibres of the wood, there are two distinct appearances. There are series of white and shining laminae, which shoot from the centre towards the circumference, and these constitute what is called the *silver grain* of the wood. There are likewise, numerous series of concentric layers, which are usually called the *spurious grain*, and their number denotes the age of the tree. The silver grain is elastic and contractile, and it has been supposed by Mr. Knight, that the contractions produced in it by changes of temperature are the principal causes of the sap's ascent.” (*Third Agricultural Lecture.*)

As Keith observes, the term *silver grain* seems to be synonymous with that of the medullary rays already noticed at No. 326. On a longitudinal cleft being made in the trunk of most trees, but particularly of an elm, they appear in fragments of thin and vertical scales, in plates, interlacing the ascending tubes in a transverse direction, and touching them at short intervals, so as to appear like irregular wicker work, or a sort of web. Such, then, being the close union of the plates and sap-vessels, the propulsion of the sap in the latter may be accounted for, by the alternate contraction and dilata-

\* Horace Benedict de Saussure was a native of Geneva: he wrote many essays, &c., relating to philosophy and natural history. In 1788, he reached the summit of Mont Blanc. He died, at the age of 59 years, on the 22d of January, 1799.

tion of the silver grain, if we allow it to be susceptible to change of temperature. Such appears to be the theory, and it was thought to be established by the following facts:—"On the surface of an oaken plank that was exposed to the influence of the sun's rays, the transverse layers were observed to be so considerably affected by change of temperature as to suggest a belief that organs which were still so restless now that the tree was dead, could not have been formed to be altogether idle while it was alive. Accordingly on the surface of the trunk of an oak, deprived of part of its bark, the longitudinal clefts and fissures, which were perceptible during the day, were found to close during the night. But, in the act of dilating, they must press unavoidably on the longitudinal tubes, and consequently propel the sap; while in the act of contracting, they again allow the tubes to expand, and take in a new supply."

395. *Dutrochet's electrical theory*.—Professor Amici, of Modena, having by the microscope observed, in the aquatic plant, called *chara vulgaris*, a regular circulation of the sap, whereby transparent globules, of various sizes, appeared to circulate in regular and uninterrupted motion, in two opposite alternating streams, in the two halves or sections of the same single cylindrical vessel, which runs lengthways through the fibres of the plant, attended with other curious phenomena, ascribed the whole to galvanic agency; since, "*by means of galvanism*, water may be conducted from the positive to the negative pole, raised contrary to the laws of hydraulics, above its level, and made to pass through the pores of a bladder which are otherwise impermeable." M. Schultz, of Berlin, "noticed a rapid movement of the sap in the nerves of a leaf of *chelidonium majus* (celandine), when examined by the microscope; and he satisfied himself that he saw two distinct currents, namely, one ascending, and another descending." M. Dutrochet, correspondent of the *Institut* at Paris, undertook the investigation of this delicate subject, and the result of his labours are four papers or treatises, published at Paris, in the years 1826, 1827, and 1828; the first of which is entitled, "*L'Agent immédiat du Mouvement vital, dévoilé dans sa nature, et dans sa mode d'action, chez les végétaux et chez les animaux*." "M. Dutrochet commences his inquiry with a determination of the channels by which the sap is conveyed through plants. M. Decandolle had supposed that the sap ascends through what he called the lymphatic vessels, the *fausses trachées* of Mirbel\*; and the truth of this conjecture has been put beyond a doubt, by Dutrochet. These vessels are situated both in the *alburnum* and heart-wood, but they

\* These are not the spiral vessels, but others, with membranous sides, described at No. 311.

are never found in the bark, nor in the medulla. These sap-vessels are simple tubes without valves, and have no lateral communication with each other."

His experiments led him to conclude that the *spongiolæ*, or oval spongy bodies, which are attached to the fibrils of the roots, imbibe fluids from the soil, and cause it to pass into the ascending sap-vessels by the aid of electricity.—(See article *Water*, page 108, No. 103—c.)

396. *Nature of the impelling Force*.—"Having taking the cæcum, or blind-gut, of a chicken, and cleansed it with pure water, he filled it half full with 196 grains of milk; and having tied up its open extremity, he placed it in water. At the end of twenty-four hours, the cæcum had imbibed 73 grains of water: and in twelve hours more, the quantity of matter imbibed was 117 grains, and the cæcum had become swollen. From this period, the cæcum experienced a gradual diminution of weight, and at the end of thirty-six hours, it had lost 54 grains of the water which had formerly entered it, and the contained milky fluid had grown putrid.

Here, then, we have exhibited to us two opposite actions of the organic membrane:—First, that by which the water is imbibed; and second, that by which it is expelled. In the first of these cases, the milk, or internal fluid, was *denser* than the water, or external fluid; and while this state of the fluid continued, the cæcum continued to imbibe the water; but as soon as the milky fluid became putrid, and thinner than the external water, the latter passed out of the cæcum as rapidly as it formerly entered it. To these two powers by which an external fluid can be taken into an organic cavity, and again discharged from it, M. Dutrochet has given the names of *Endosmose*, and *Exosmose*; the one derived from *ενδον*, *inward*, and *ωσμος*, *an impulse*; and the other from *εξ*, *out*, and *ωσμος*, *an impulse*. As the turgidity produced by the imbibition of the water stretches the sides of the cæcum, so as to cause them to re-act on the enclosed fluid, our author was of opinion that this re-action would be capable of causing it to rise in a tube fixed to the cæcum, when in a state of endosmose. He accordingly took a glass tube, twenty-four inches long, and about one-fifth of an inch in bore, and fixed one end in the cæcum of a chicken, containing a solution of gum-arabic. The glass tube, being held in a vertical position, and the cæcum being immersed in rain water, the enclosed fluid rose in the tube, and at the end of twenty-four hours it began to discharge itself from the upper orifice. This overflow continued for two days, when it began to sink. Upon opening the cæcum on the fourth day, the enclosed fluid was found in a state of putridity. M. Dutrochet ob-

tained similar results by substituting for the cæcum the inflated bladder of the *colutea arborescens*, or bladder senna."

397. *Inquiry into the Cause.*—"An experiment by Porret could not fail to suggest, that the phenomenon exhibited by animal and vegetable membranes was the result of electrical action. This chemist having divided a cylindrical jar into two compartments, by a piece of bladder, he filled one of the compartments, and left the other almost empty, with only a few drops of water in it. When the zinc pole of a galvanic pile was placed in the full compartment, and the copper pole in the empty one, the water passed from the full into the empty compartment, and rose in the latter much higher than it originally stood in the former. Following up the idea suggested by this remarkable experiment, M. Dutrochet tied the extremities of two tubes, one of which was capillary, to the pod of the *colutea arborescens*. He now introduced the *negative* wire through the cork of the ordinary tube, into the pod, and then immersed the *positive* wire into a vessel of water in which the pod was placed. The pod quickly became swollen by the imbibition of the external water; and the water, rising in the capillary tube flowed over its upper extremity, exactly in the same manner as it would have done by virtue of the force of endosmose, had the pod separated two fluids of different densities. The same result was obtained by substituting the cæcum of a chicken in place of the vegetable membrane. That endosmose was an electrical action was rendered highly probable by the following experiment:—Our author introduced the white of an egg into the cæcum of a chicken, and when it was nearly full, he closed it, and plunged it into water. The cæcum speedily became turgid; and after the action had continued some hours, a layer of coagulated albumen was found upon its inner surface—on of the known effects of voltaic action." From the experiments now briefly described, M. Dutrochet concludes, "*That it is by the action of endosmose that the sap is raised to the highest summit of trees contrary to its natural gravity; and that this force is the result of electrical action.*"

Such is the outline of the theory of Dutrochet as extracted almost verbatim from the *Foreign Review* of Jan. 1829. The hypothesis is evidently founded upon the philosophical fact, that electric action is frequently excited between fluids of different densities, when such fluids are separated by some membranous substance; and he thus exemplifies the fact:—"If we put," says he, "the albumen" (the white) "of an egg into a wide glass tube, and if pure water be carefully poured upon it from above, no mixture of the two fluids will take place, and the line of demarcation which separates them

will be distinctly seen. But this line of demarcation will never vary, and the albumen will undergo no augmentation of volume, however long the experiment be continued. This proves beyond a doubt, that the albumen has no affinity for the water which covers it; whereas, if the same two substances *are separated by a membrane*, the water will pass across it, and accumulate itself on the side of the albumen, and speedily mix with it. Hence, it is to another cause than to the reciprocal affinity of fluids that we must attribute this phenomenon;" and this cause the author conceives to be *electricity*, generated by the contact of the two fluids with the separating membrane.

The electricity so generated is not discoverable by the galvanoscope; it is not to be detected by instruments; hence, its presence is denied, or, at least, doubted by many; and this is a natural consequence of the present state of the electrical science. *Electricity in masses*, is the thing sought for, and studied; but the electricity of nature, that subtle specific fluid, which is the source of all chemical attraction and chemical union, is but little thought of, and still less understood; although there does not exist throughout all nature another agent, to whose operation we can refer the secret and silent changes of the atmosphere, from a dry to a moist state, and *vice versâ*, or to speak more correctly, by which we can hope to account for the conversion of aqueous vapours into atmospheric air—a change productive of increased weight and density;—or, for the reproduction of aqueous vapours, in consequence of the decomposition of air through which decomposition, the ærial volume is rendered less dense and specifically lighter.

398. *Consequences of Dutrochet's Theory.*—The Reviewer is certainly correct, when he observes, at page 91, that, "to the science of vegetable physiology, the discoveries of M. Dutrochet have an immediate application. They form," he adds, "an epoch in its history: as from a new goal, the science starts with powerful instruments of research, and with fresh prospects of success. The discovery of endosmose, and of the cause of the ascent of the sap in plants, is, to vegetable physiology, what the establishment of the law of gravity was to astronomy. While it binds together the scattered elements of the science it lays the foundation of an inductive superstructure, which can be reared only by men of varied talent, who combine the accomplishments of the chemist and the natural philosopher, with the knowledge and patient observation of the botanist."

Subsequent to the appearance of the first edition, I was sorry to perceive that M. Dutrochet speedily abandoned his hypothesis, for one

more purely mathematical. Every philosopher, who by argument, or by more minute observation, becomes convinced that he has been under a mistake, is perfectly justified in abandoning an hypothesis which he believes to be no longer tenable; and he ought to be lauded for the candour which leads him to avow—what we may still regret—the change of his opinion.

To effect the intromission of the prepared fluids into the roots, and the propulsion of the sap through the cellular vessels by which it ascends, we must look for an agency more appropriate and powerful than any which has been advocated by the philosophers whose theories have been mentioned in the preceding paragraphs. If we are not prepared to admit that the vegetable vital principle exerts itself in such a way as to leave little doubt that plants are thereby endued with sensation and volition, we have, I think, no other alternative, than to consider them as beings possessing an organized structure, that constitutes them the immediate instruments of electric conduction, the *laboratories of light*; by the electrizing principle of which, a multitude of chemical changes are effected, and substances produced, that are of the utmost utility to man and animals.

399. *Electrical Theory of the Cause of the Sap's Ascent.*—To prevent needless repetition, the reader is referred to the electrical theory at No. 66, and to the theory on *vegetable nutrition* at c, No. 103. To these it may be added, that—the solar light, in its passage through the vegetable vessels, operates by induction, and attracts those fluids which have been prepared by electro-chemical agency, in the immediate neighbourhood of the rootlets of plants. That the prepared fluids, now become sap, are propelled along the sap-vessels by the conjoint agency of induction, and of developed electricity; and that a portion of the sap is, in its passage, taken up by “endosmose,” or lateral attraction, through the substance of the vegetable membrane, and becomes diffused throughout the parenchyma, by a series of attractions—exerted between fluids of different densities, till it is finally deposited, in a perfected state, in appropriate cells.

Such is a faint outline of what appears to me to be the nature of vegetable vital action; but in the present state of science, when electro-chemistry has, as it were, made only its first advances, it would be presumptuous to attempt to give a particular description of the infinite variety of processes which are effected throughout the vegetable structure; especially, as in fact, the minutiae of that structure itself, are involved in considerable doubt and uncertainty.

400. *Process of Vegetable Nutrition.*—Before I proceed in this

inquiry, it will be proper to caution the reader against a very obvious and common error. As physiologists, in consequence of the limited powers of language, are constrained to describe the various processes of nature in successive detail, the young student is naturally inclined to infer, that the agents which affect vegetable developements, are called into operation one after the other, in a sort of routine order:—thus, that the sap first rises early in spring, causes the bursting of the buds, and the expansion of the leaves; then returns, is distributed throughout the vegetable cells, and propels the growth of the radical fibres. That vegetable developements take place, or become apparent, in successive and regular order, there can be no question; but the exciting causes act simultaneously,—they are the operations of one grand effort of inductive agency. Thus, from the moment of the first germination of the seed, the descending and ascending fluids, the lateral attractions and diffusions of the nutritive and prepared juices, the formation of vegetable membrane, of organized vessels, and the protrusion of fibrous roots; these, and all other processes of vegetable vitality, are induced and carried on at one and the same moment of time; for as each is primarily dependent on the stimulus, so are they all essentially accessory, the one to the other. There is, however, in most plants, a developement of new roots, which apparently precedes the enlargement of the buds; still, though new roots become visible, in the first instance, the stimulus of the vital principle and fluids must have been exerted throughout the vegetable structure to effect their developement.

If there be any priority of order, I am inclined to refer it to the agency of light upon the vegetable pointed terminations, effecting the first chemical changes in the expanding buds, propelling the juices downwards, and attracting the ascending nutritive fluids upwards. This idea leads me to observe,—and I believe I shall be supported in the observation by one or more contemporary writers,—that there is reason to suspect the commonly received opinions concerning the flow of the sap, to be founded in error. It is familiarly known, that some trees which have long been felled, will sprout vigorously in the spring; a branch of a vine trained within a forcing house, will push, while the external air is frosty, and all the branches in the open air remain in a state of apparent torpor. The effort in the felled tree cannot depend upon juices absorbed from the soil: the pushing of the vine cannot arise from the fermentation excited by the natural heat around the roots; these developements, therefore, must be effected by other agencies—they must be traced to other causes. May we not ascribe the spring flow of the sap to the absorption and decomposition of atmospheric air, effected by attraction,

closely resembling, if not identical with the "*endosmose*" of Dutrochet, and exerted between the denser fluids within the buds and branches, and the lighter fluids of the air through the medium of the membrane of the epidermis? The vitality of the plant, during those seasons when it appears to be in a quiescent and torpid state, is in all probability maintained by this species of lateral attraction between fluids of different densities; but the bursting of the buds in spring, the protrusion of the roots, the production of leaves and flowers, and the general growth and enlargement in the bulk, must be referred to the more energetic operations of electric agency, among which operations, the developement of heat is one of the most astonishing and influential.

401. *Mr. Knight's Theory of the Progress of the Sap.*—Having thus premised, I proceed with the details of this theory, in order to explain the mode in which the vegetable secretions and developments are effected. "By far the greater portion of the sap is carried into the leaves, of the great importance and utility of which to the plant itself, Mr. Knight's theory is the only one that gives us any adequate or satisfactory notion. In those organs the sap is exposed to the action of light, air, and moisture, three powerful agents, by which it is enabled to form various secretions, at the same time that much superfluous matter passes off by perspiration. These secretions not only give peculiar flavours and qualities to the leaf itself, but are returned by another set of vessels," (see 316-17,) "as Mr. Knight has demonstrated, into the *new layer of bark*, which they nourish and bring to perfection, and which they enable, in turn, to secrete matter for a *new layer of alburnum* during the ensuing year. It is presumed, that one set of the returning vessels of trees may probably be more particularly destined to this latter office, and another to the secretion of peculiar fluids in the bark." (See *Phil. Trans.* for 1801, p. 337.) "In the bark principally," says Dr. Smith, "if I mistake not, the peculiar secretions of the plant are perfected, as gum, resin, &c., each, undoubtedly, in an appropriate set of vessels." From what has just been stated of the office of leaves, we readily perceive the cause why that portion of a branch, situated above a leaf or a leaf-bud, dies, when the bud immediately above it is cut off; for each intermediate portion of the stem, between leaf and leaf, derives nourishment, and the means of increase, from the leaf or bud above it.

By the foregoing view of the vegetable economy, "it appears that the *vascular system of plants is strictly annual*. This, of course, is admitted in herbaceous plants, the existence of whose stems, and often that of the whole individual, is limited to one season; but it is

no less true with regard to trees. The layer of alburnum, on the one hand, is added to the wood, and the *liber*, or inner layer, of the bark is, on the other, annexed to the layers formed in preceding seasons, and neither have any share in the process of vegetation for the year ensuing. Still, as they continue for a long time to be living bodies, and help to perfect, if not to form secretions, they must receive some portion of nourishment from those more active parts, which have taken up their late functions.”—(*Introduction to Botany*, 55 to 57.)

402. *Descent of the proper juice.*—“When the sap has been duly elaborated in the leaf, it assumes the appellation of *cambium*” (possibly from *cambio*, to change), “or proper juice of the plant. In this ultimate state of elaboration it is found chiefly in the bark, or rather between the bark and the wood, and may very often be distinguished by a peculiar colour, being sometimes white, as in the several species of spurge, and sometimes yellow, as in the celandine. It is said to be the principal seat of the medical virtues of plants; and was regarded by Malpighi as being to the plant what blood is to the animal body—the immediate principle of nourishment, and grand support of life.”

The *cambium*, in the new hypothesis of Mr. James Main, is considered, not as perfected sap, but as a *vital membrane*, termed by him the *indusium*. If I rightly appreciate this gentleman’s doctrine, it presumes that every vegetable body is perfect in itself, containing, from the moment of its earliest developement, all the organs necessary to its being,—that these merely become visible in due time and order,—are nourished, but not created, or formed, by the vital fluids. Infinite minuteness can never be raised as an argument against such a theory, because infinite creative power cannot be appreciated by weak and finite man.

“One of the earliest and most satisfactory experiments on the return of the proper juice through the leaf and leaf-stalk, is that of Dr. Darwin, which was conducted as follows:—A stalk of the *Euphorbia helioscopia*, furnished with its leaves and seed-vessels, was placed in a decoction of madder-root, so as that the lower portion of the stem, and two of the inferior leaves were immersed in it. After remaining so for several days, the colour of the decoction was distinctly discerned passing along the mid-rib of each leaf. On the upper side of the leaf many of the ramifications, going from the mid-rib towards the circumference, were observed to be tinged with red; but on the under side, there was observed a system of branching vessels, originated in the extremities of the leaf, and carrying not a red, but a pale milky fluid, which, after uniting in two sets, one on

each side the mid-rib, descended along with it into the leaf-stalk: these were the vessels returning the elaborated sap. The vessels observable on the upper surface Darwin calls arteries, and those on the under surface he calls veins. To this may be added the more recent discoveries of Knight; who, in his experiments, instituted with a view to ascertain the course of the sap, detected in the leaf-stalk, not only the vessels which he calls central tubes, through which the coloured infusion ascended, together with their appendages, the spiral tubes, but also another set of vessels surrounding the central tubes, which he distinguishes by the appellation of external tubes, and which appeared to be conveying, in one direction or other, a fluid that was not coloured, but that proved, upon further investigation, to be the descending proper juice. In tracing them upwards, they were found to extend to the summit of the leaf, and in tracing them downwards, they were found to extend to the base of the leaf-stalk, and to penetrate even into the inner bark. According to Knight, then, there are three sets of vessels in leaves—the central tubes, the spiral tubes, and the external tubes.

“ But by what means is the proper juice conducted from the base of the leaf-stalk to the extremity of the root? This was the chief object of the inquiry of the early physiologists, who had not yet begun to trace its progress in the leaf and leaf-stalk, but who were acquainted with facts indicating at least the descent of a fluid in the trunk. If the stem, or branch, or even root of a woody plant is encircled with a strong ligature, a tumour is formed above it. (*Phys. des Arbres*, liv. v.) Hence they inferred the descent of a fluid that was now stopped; but this descending fluid was proved also to be *cambium*, or proper juice. Du Hamel stript sixty trees of their bark in the course of the spring, laying them bare from the upper extremity of the sap and branches to the root; the experiment proved indeed fatal to them, as they all died in the course of three or four years; but many of them had made new productions, both of wood and bark, from the buds downwards, extending, in some cases, to the length of a foot, though very few of them had made any new productions from the root upwards. Hence it is, that the proper juice not only descends from the extremity of the leaf to the extremity of the root, but generates, in its descent, new and additional parts.

“ If a ring of bark is detached in the spring from the trunk of an olive-tree, it will produce that year a double quantity both of blossoms and fruit, though it will soon afterwards die; but the phenomenon is easily accounted for. The preternatural fertility of the plant is owing to the unusual accumulation of proper juice in the leaves

and branches, in consequence of the interruption of the descent of the proper juice; and the subsequent death of the plant is owing to the privation of nutriment sustained by the root, in consequence of the same cause\*. The experiments of Knight on this subject are, if possible, more convincing than even those of Du Hamel. From the trunks of a number of young crab-trees, he detached a ring of bark of half an inch in breadth. The sap rose in them, and the portion of the trunk, above the ring of bark, augmented as in other subjects that were not so treated, while the portion below the ring scarcely augmented at all. The upper lips of the wounds made considerable advances downwards, while the lower lips made scarcely any advances upwards; but if a bud was protruded under the ring, and the shoot arising from it allowed to remain, then the portion of the trunk below that bud began immediately to augment in size, while the portion between the bud and the incision remained nearly as before. When two circular incisions were made in the trunk, so as to leave a ring of bark between them with a leaf growing from it, the portion above the leaf died, while the portion below the leaf lived; and when the upper part of a branch was stripped of its leaves, the branch withered as far as it was stripped: whence it is evident, that the sap which has been elaborated in the leaves, and converted into proper juice, descends through the channel of the bark, or rather between the bark and the alburnum, to the extremity of the root, effecting the developement of new and additional parts." —(KEITH'S *Phys. Bot.*, Vol. II., c. iii., sect. 8.)

403. The reader is now in possession of many most important facts, which point out the course of the descending elaborated sap, or proper juice. I have endeavoured throughout the work, to render it evident, that this descending current of the vegetable juices is, and can be effected, solely by the agency of the electrizing principle of light; which principle acts by induction, and produces the ascending current of the sap. The sap, I have suggested, has its origin in the juices of the soil and manures, first duly prepared by electro-chemical divellent attraction; and is then attracted and propelled into the spongiolæ and rootlets, by the conjoint influence of inductive agency, and of the electricity developed during the elaboration of the nutritive juices of the soil. The theory of M. Dutrochet takes up the subject, and explains how, by the process of *endosmose*, the vegetable fluids may be mutually attracted and

\* *La Nature Dévoilée*.—Here we trace, very evidently, the origin of the operation of *ringing*, in order to induce fruitfulness.

changed within the vascular organs; and finally distributed throughout the substance of the plant in their appropriate cells. Nothing now remains to complete these elementary sections on Vegetable Physiology, but to adduce other facts connected with the order of the economy of plants, which may tend to elucidate, or to be themselves elucidated by, the theories thus embodied into one.

404. *Origin of the Liber and Alburnum*.—"Du Hamel," says Dr. Smith, "by many experiments, proved the wood to be secreted or deposited from the innermost part of the bark or *liber*. He introduced plates of tin foil under the barks of growing trees, carefully binding up their wounds, and, after some years, on cutting them across, he found the layers of new wood on the outside of the tin. His *original specimens* I have examined in the public museum at Paris.

"Dr. Hope, the late worthy Professor of Botany at Edinburgh, instituted an experiment, if possible more decisive, upon a branch of willow three or four years old. The bark was carefully cut through, longitudinally, on one side, for the length of several inches, so that it might be slipped aside from the wood in the form of a hollow cylinder, the two ends being undisturbed. The edges of the bark were then united as carefully as possible, the wood covered from the air, and the whole bound up to secure it from external injury. After a few years, the branch was cut through transversely. The cylinder of bark was found lined with layers of new wood, whose number, added to those in the wood from which it had been stripped, made up the number of rings in the branch above and below the experiment. For an account of this experiment, I am indebted to Dr. Thomas Hope, the present chemical professor at Edinburgh\*."

"Du-Hamel engrafted a portion of the bark of a peach-tree upon a plum. After some time he found a layer of new wood under the engrafted bark, white, like that of the peach, and evidently different from the red wood of the plum. Moreover, in this and other experiments made with the same intention, he found the layers of new wood always connected with the bark, and not united to the old wood. See his *Physique des Arbres*, Vol. II. 29, &c. It deserves also to be mentioned, that by performing this experiment of engrafting a portion of bark at different periods through the spring and summer, the same accurate observer found a great difference in the thickness of the layer of new wood produced under it, which was

\* Dr. Hope died in the year 1786.

always less in proportion as the operation was performed later in the season.

“That the bark or *liber* produces wood seems therefore proved beyond dispute; but some experiments persuaded Du-Hamel that in certain circumstances the wood was capable of producing a new bark. This never happened in any case but when the whole trunk of the tree was stripped of its bark. A cherry-tree treated in this manner, exuded from the whole surface of its wood, in little points, a gelatinous matter, which gradually extended over the whole, and became a *new bark*, under which a layer of new wood was speedily formed. Hence, Mirbel concludes, Vol. I. 176, that the alburnum and the wood are really the origin of the new layers of wood, by producing first this gelatinous substance, or matter of organization, which he and Du-Hamel call *cambium*, and which Mirbel supposes to produce the *liber*, or young bark, and at the same time, by a peculiar arrangement of the vascular parts, the *alburnum* or new wood.”—(SMITH'S *Introd.—Wood*, ch. 6.)

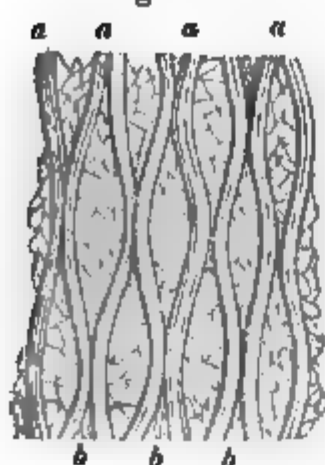
405. *These experiments seem to prove to a demonstration, that a lateral action\* or attraction is exerted between the bark and the wood of the last year; for, as the former encloses the latter as in a case or tube, and as the alburnum is produced between both, and immediately under the bark, it follows of necessity that the juices of the one must be attracted by those of the other. The experiments appear also to afford satisfactory evidence, that the bark, being the medium through which the descending perfected juices flow, must be the natural origin of the young wood, although, as an exception to the rule, the wood may, in cases of emergency, produce a new covering of bark. This lateral action and production of new intermediate parts are not the only phenomena exhibited; for experiments prove that a downward descending action must at the same time be excited; because bundles of vascular fibres are generated and carried down to the extremities of the roots. These fibrous processes are discernible by the eye, unassisted by glasses, on the bark which is stripped off oak-trees at the season of “falling” timber in the spring. The innermost layer, or *liber*, has somewhat the appearance of net-work, and, when carefully prepared, exhibits bundles of vascular fibres running in a perpendicular or wavy direction downwards, interspersed with masses of cellular membrane.*

In the annexed figure, *a a a a* represent the bundles of fibres: these were viewed as the descending vessels that convey the proper juices: *b b b* show the cellular masses between the vessels.

\* The success of the operation of *budding* assuredly depends upon this attraction.

It may be, that between the bark and the wood of the preceding year, an attraction is exerted which first produces a deposition of matter,—the basis of the

Fig. 20.



new wood; and, secondly, a new layer of bark, or the matter of bark, upon, and in close contact with, that woody matter. During the operation of this, "endosmose," the ascending and descending currents, setting between the atmosphere and the nutritive fluids of the soil, are in full activity; and to these cross currents—the effects of inductive agency—we may, I think, philosophically ascribe the first development of the vascular system of the newly de-

posited matters, and the final and perfect organization of the wood and bark: or we may suppose with Mr. Main that, a membrane or some substance equivalent to one—call it *cambium*, *indusium*, or what else—is provided by nature, and gradually becomes developed or organized into *liber* and *alburnum*. This formation, or development, is one of those hidden mysteries, which the experiments of man cannot unravel.

## SECTION II.

### PART I.

#### NATURAL HISTORY AND CULTIVATION OF ESCULENT VEGETABLES.

Subject 1. The ARTICHOKE:—*Cynara Scolymus*; *Compositæ*. Class xix. Order i. *Syngenesia Polygamia Æqualis*, of LINNÆUS.

406. The *Artichoke*, according to the *Encyclopædia of Gardening*, is a native of the south of Europe, and was introduced into England in 1548. It has large fleshy fibrous roots, which produce a head of erect winged leaves, from two to four feet high. In the midst of this head arises an upright stem, two or three feet in height, which is terminated by an oval or roundish flower-head, whose rigid scales, or leaves, form the general calyx that encloses the florets. This universal calyx is "imbricated,"—that is, the scales which compose it are placed in alternate order, one over the other, in a way some-

what resembling that in which tiles are laid on the roof of a house. The florets are numerous: they appear in August and September, are tubular, of a beautiful lavender-blue, or blueish-purple colour; each has five slender stamina and one style, and is succeeded by an oblong downy seed.

“The flower-heads, in an immature state, contain the part that is used, which is the fleshy receptacle, commonly called the bottom, freed from the bristles and seed down, vulgarly called the *choke*, and the *talus*, or lower part of the leaves of the calyx. In France, the bottoms are commonly fried in paste. They are sometimes used for pickling, or are slowly dried and kept in bags for winter use: the bottoms of young artichokes are frequently used in the raw state as salad; thin slices are cut from the bottom with a scale or calyx leaf attached, by which the slice is lifted, and dipped in oil and vinegar before using.”—(See *Enc.* 3918.)

407. *Varieties*.—There are two cultivated varieties of the *Cynara Scolymus*, known by the common term *Artichoke*; and one distinct species, the *Cynara Cardunculus*, or Cardoon. The two cultivated varieties are:—

1. The *conical*, ovate, or oval French artichoke: the heads are of a green colour; the scales pointed, and turning outwards.

2. The *globular*, or large round-headed artichoke; with dusky, purplish heads; the scales turned in at the top.

“The artichoke,” Abercrombie observes, “is more of a delicate than profitable esculent; the flower-head, when arrived to full size, is the only eatable part; it consists of the bottom or stool, being the common receptacle, which is broad, thick, fleshy, together with the fleshy part of the base of the scales, which adhere to the bottom.” The globe, or round artichoke, is mostly preferred, as being the best artichoke for chief crops; but the first variety is full in flavour: both are hardy perennials, and produce heads from July to November.

“The cardoon is not greatly admired in England; the stalks of the leaves, when blanched, are the useful part: they grow very large, three, four, or five feet high; and, in autumn, when full grown, being tied up close together, and landed up all round, to blanch and render them tender and well-flavoured, which otherwise would be intolerably rank and bitter, are then fit for use, proper for stewing, soups, salads, &c.”

408. *Propagation*.—The artichoke may be raised from seed sown in March, in rows afoot apart. The young plants are to be thinned when they are an inch or two in height, to ten or twelve inches asunder; and finally transplanted in autumn to the spot where they are to remain. But the readiest mode of propagation is by the

off-set suckers, which are produced abundantly from the roots of the old plants. M'Phael, when speaking of this mode of culture, says, "Artichokes require a deep soil. Before they are planted, trench the ground well, about two feet deep, and put plenty of dung on it, if it be poor: they love as rich a soil as any herbaceous plant I know. When the ground is dug and levelled, mark out the rows five feet apart, and set the plants in clumps three or four in each, two feet asunder; give them water, and keep them watered in dry weather during the summer."

Abercrombie gives nearly the same directions:—"Let the ground for a plantation of artichokes be well dunged, and digged in, one or two spades deep. Then in spring, having procured a quantity of good suckers, let them be trimmed, by cutting off any hard knotty part at bottom, stripping off any broken or straggling leaves, and trim the tops of the larger outer ones; and then plant them by line and dibble, in rows five feet distance, by two and a half in the row, giving directly a good watering to settle the earth;—&c."

For the reasons assigned at No. 110, I would recommend the work of planting to be performed in detail, row by row, and that the ground be digged as the work proceeds.

409. *Subsequent Culture*.—"All spring and summer keep them clear from weeds, by occasionally hoeing between the plants. This, with regular waterings in the dry weather, is all the culture which they require till the season of production is terminated. In August and September of the same year of planting the artichokes, they will produce a crop of fruit in great perfection, and continue fruiting, in gradual succession, till November; but next year they will begin fruiting in June and July.

"Every two years it is proper to manure the artichoke ground where old plantations are continued, applying a good coat of well-rotted dung in November or December, at the time of landing up, digging it in, as you proceed in ridging up the plants."—(ABERCROMBIE.)

"Nicol mentions, that the strongest crops he ever saw, grew in rather a mossy earth that had been trenched fully a yard in depth, and had been well enriched with dung, and limed; and that the plants were generally covered before winter with a mixture of stable-litter and sea-weed.

"This last article, we believe, is one of the very best manures for artichokes. In no place is the plant to be seen in greater perfection than in gardens in the Orkney Islands; and we know that the luxuriance of the plants in these is to be ascribed to the liberal supply of sea-weed dug into the ground every autumn. It was long

ago remarked by a horticultural writer, that 'water drawn from ashes, or improved by any fixed salt, is very good for artichokes. (*Systema Agriculturæ*, 1682.)'—*Encyc.* No. 3923.

Does not the latter remark call for the attention of experimental gardeners to the prudent use of salt and nitre, either sown over the ground lightly, and digged in, or applied as a liquid manure?

*Soda*—that is the crystallized carbonate of soda of commerce—has lately been much extolled for its stimulating properties: it certainly is free from the acid of sea-salt, but it can only act beneficially upon vegetation by promoting the solubility of manures. We do not, however, want to dissolve these substances rapidly, for it is the gradual decomposition of the manure by the vital action of plants, which generates *sap*, and promotes their growth.

410. *Winter Dressing in October or November.*—"Clear your artichokes of weeds and all sorts of rubbish, and cut the stems of them close down; and in this something should be done to them to keep the frost from their roots. If the rows of plants are at least four feet apart, lay a little covering of dung on the plants; then, exactly between the rows, dig out about eighteen inches wide of earth, and lay it on about the plants, forming a gentle ridge with it; dig out the earth so deep as to cover your plants well, that the frost do not get at the roots of them. Taking out the mould to cover them, makes a deep trench, which drains the water from the plants during winter, so that the roots are preserved from too much wet, as well as frost.

"If your artichokes stand close in the rows, you had best cover them well with long litter, to keep the frost out during winter." (M'PHEAL'S *Gard. Rem.*, October.)

"When winter comes on, if hard frosts come, the clumps should be covered pretty thickly with litter, which, however, should be taken off again as soon as the frost is *out of the ground*; but no plant, which has been covered to be protected from the frost, should be uncovered, and the sun left to come upon the ground where it stands, before the thaw has completely [taken place]."—(COBBETT'S *Eng. Gard.* 119.)

411. *Spring dressing.*—"In spring, when they make new shoots in March and April, six or eight inches long, is the time to level down the ridges of earth, to dig between and about the roots, and, at the same time, to slip off the superabundant shoots, and of which to procure young plants with as much root as possible; leaving two or three of the best outward ones standing on the stool or stock; reserving as many of the best of those slipped off, as may be required for a new plantation."—(ABERCROMBIE.)

“Towards the latter end of the month” (March), “or sooner, the artichoke plants will require dressing. Level down the ridges of earth which were made to preserve them from the frost; then, proceed to take off all the superfluous suckers, leaving from four to eight of the strongest to produce fruit. When this is done, lay, if they want it, some manure among them, and dig it cleverly about the roots. The best artichoke slips that were taken off, will do to make a new plantation if it be required.”—(*Gard. Remem.* March.)

412. The artichoke plantations will, if properly attended to, be productive for many years; but it will be prudent to renew the stock, by forming new beds yearly, or once in two or three years; for as the old plants produce heads in June and July, the newly-set roots will bear, if the offsets be strong, in the succeeding August and September, and later: and again, beds of strong offsets, planted in April, will produce as late as November: thus a succession may be kept up for five months.

413. *Saving the Seed.*—Artichoke plants do not always ripen their seed in this climate: in order, therefore, to obtain matured seed, some of the finest and earliest heads must be suffered to remain uncut. They will soon come into flower, and in dry warm summers, may probably produce ripe seed. This must be gathered in a perfectly dry state, be retained in the head till all the moisture be completely gone, and then rubbed out. In a dry room, the seed will keep sound for three or four years.

Subject 2. SPINACH OR SPINAGE:—*Spinacea oleracea*; *Chenopodeæ*.  
Class xxii. Order v. *Diacia Pentandria*, of Linnæus.

414. *Spinach*, according to the *Encyc. of Gardening*, was, in all probability, cultivated here before the year 1568: it is supposed to be a native of western Asia. It has roundish, oval, or triangular leaves, in clusters; succeeded by an upright, thick, hollow stalk, two feet or more high, though sometimes, in an anomalous spring, as of 1829, the plant, in some places, runs to seed after it has risen about an inch or two above ground. This flower-stalk produces “terminal male spikes, and lateral female clusters of small greenish flowers, without petals. The male and female blossoms are on separate plants, having five-parted cups in the males, and four-parted ones in the females; no petals; five capillary male filaments; and in the females, a roundish germen, supporting four hair-like styles; and the germen becomes a roundish, prickly, or smooth seed, in the varieties, enclosed in the permanent calyx.”—(*ARNDSTON'S Dict.*—“*Spinacea*.”)

415. *Varieties*.—1. Common *round-leaved*, smooth-seeded, Spinach, preferred for spring culture, as the leaves are thicker and more juicy.

2. Oblong *triangular-leaved*, prickly-seeded Spinach, considered the more hardy, and suitable for winter culture.

416. *Soil and Culture*.—Spinach is raised from seed, sown in spring, summer, and autumn, in any common open ground, broadcast, and raked in, or in flat drills; it may be cultivated, by different sowings, from January until August or September, at about a month's or three weeks' interval between each sowing in the spring, and a fortnight's in summer, as the summer and spring crops soon fly up to seed the same year; but the autumnal sowings, in August and September, continue in perfection all that season, and through the winter, until next March, April, and May; then shoot up stalks for flower and seed, and are succeeded by the early spring and second crops, arriving to perfection in April, May, and June. The early sowing may be commenced in January, or the beginning of February, performing the earliest sowings in a warm border, or other sheltered situation.

Two ounces of seed will sow a bed four and a half feet wide by thirty feet long, if sown broadcast; but in drills, one ounce will sow the same space.—(*Idem.*)

417. *Sow the seeds in drills* in preference to broadcast, as the beds can then be more readily kept well hoed: beds of four feet wide, with alleys between them, afford every requisite convenience, and the drills therein may be made from eight to ten inches apart, and two inches deep. If room be deficient, the spring sowings can be made between rows of cabbages, peas, beans, &c. As the spinach advances in growth, draw earth to the stems of the plants—it will nourish and strengthen them.

418. *Subsequent Culture*.—"When the plants are up, showing leaves about an inch broad, clear them from weeds, either by hand or small hoeing; and thin the plants, where crowded, (especially the broadcast crops,) to three inches apart; and, when advanced in growth, every other may be cut out for use, increasing the distance to about six inches, that the remainder may grow stocky, with large spreading leaves. The plants of the early and successive crops attain proper growth for gathering in April, May, and June. When the leaves are from two to five inches in breadth, cut the plants clean out to the bottom; or sometimes, cut only the larger leaves. But as soon as there is any appearance of their running to seed, they may be drawn out clean as wanted."

419. *Winter Culture*.—M'Phael directs, "in the first or second

week" of August, to "get a piece of good rich deep ground in readiness, by dunging it if it want, and digging it deep for a crop of winter and spring spinach. When your ground is dug, if it be a light soil, which is best for spinach, tread it with your feet all over, then draw shallow drills of two feet apart, with your hoo flat-wise; scatter the seeds of prickly spinach in drills, and cover them two inches deep, and make the ground smooth with a rake. You should, before you fill up the drills, set a little stick up at each end of them, that, in case of dry weather, you may stretch a line between them, which will show you where the spinach is sown, that you may water the rows if they require it. If the ground was dry on the surface, when you sowed the seed, you should have had the drills watered before they were covered. You may sow again a few rows, about the twentieth of the month."

Winter spinach is much superior to the spring, or round-leaved: it frequently may be gathered in December and January, continuing in full bearing till June or July: the inflorescence then becomes visible, and the plants should be pulled up for use, in thinning order, for they yet remain tender and juicy.

420. *To save the seed*, "either sow a quantity of each sort for the purpose, in spring and autumn; or leave some plants of the autumn or spring sowings: they will shoot up stalks in May, and flower in June; when, and not before, the male and female plants will discover themselves; the former producing its flowers in spikes, with stamina, containing the yellow male farina; the female plants exhibiting flowers in close lateral clusters at the joints of the stalk. Leave the male plants till they have discharged their farina, after which they soon decay, but the females continue their growth till they perfect the seed in July and August."—(ABERCROMBIE.) Pull up the stalks, spread them out to dry in the sun, and to harden the seed; then thresh it out for use, and keep it, as all other seeds should be preserved, in a cool dry room, in a drawer or bag.

Subject 3. NEW ZEALAND SPINACH:—*Tetragonia expansa*; *Ficoidea*.  
Class xii. Order ii. *Icosandria Digynia*, of Linnæus.

421. The whole that follows is so interesting, that I have not hesitated to extract it, without abbreviation, from page 637, of the *Encyclopædia of Gardening*. "*New Zealand Spinach* is a half hardy annnual, with numerous branches, round, succulent, pale green, thick, and strong, somewhat procumbent, but elevating their terminations. The leaves are fleshy, growing alternately at small distances from each other, in shortish petioles; they are of a deltoid

shape," (a term which implies a resemblance to the Greek letter D, or *Delta*— $\Delta$ ,) "but rather elongated, being two or three inches broad at the top, and from three to four inches long; the apex is almost sharp-pointed, and the two extremities of the base are bluntly rounded; the whole leaf is smooth, with entire edges, dark green above, below paler, and thickly studded with aqueous tubercles; the midrib and veins project conspicuously on the under surface. The flowers are sessile" (closely seated) "in the axæ of the leaves, small and green, and, except that they show their yellow antheræ when they expand, they are very inconspicuous. The fruit when ripe has a dry pericarp of a rude shape, somewhat like the cone of *Arbor Vitæ*, with four or five hornlike processes enclosing the seed, which is to be sown in its covering. It is a native of New Zealand, by the sides of woods, in bushy sandy places, and though not used by the inhabitants, yet being considered by the naturalists who accompanied Captain Cook, as of the same nature as the *chenopodium* (see FOSTER, *Plant. Esculent.*, &c.), it was served to the sailors, boiled, every day at breakfast and dinner. It was introduced here by Sir Joseph Banks, in 1772, and treated as a green-house plant; but has lately been found to grow in the open air as freely as the kidney bean or nasturtium. As a summer species, it is as valuable as the orache, or perhaps more so. Every gardener knows the plague that attends the frequent sowing of common spinach through the warm season of the year; without that trouble it is impossible to have it good, and with the utmost care it cannot always be obtained exactly as it ought to be, (particularly when the weather is hot and dry,) from the rapidity with which the young plants run to seed. The New Zealand spinage, if watered, grows freely, and produces leaves of the greatest succulency in the hottest weather. Anderson, one of its earliest cultivators, had only nine plants, from which, he says, "I have been enabled to send in a gathering for the kitchen every other day since the middle of June, so that I consider a bed with about twenty plants, quite sufficient to give a daily supply, if required, for a large table.

"It is dressed in the same manner as common spinage, and whether boiled plain, or stewed, is considered by some as superior to it; there is a softness and mildness in its taste, added to its flavour, which resembles that of spinage, in which it has an advantage over that herb."

The directions given by Mr. Anderson are correct and truly practical; this I have ascertained: the growth and productiveness of the plant are prodigious; but I have scarcely found any person who preferred the taste of the vegetable to that of the winter spinach.

## NEW ZEALAND SPINACH.

its chief merit appears to consist in being fully in season from June to November. I have raised abundance of seed by setting one plant against a south-east wall, and training the branches right and left. In 1831, I gathered the seed-vessels in succession, during September and October. It will frequently sow itself, come up in the following spring, and grow as freely as if cultivated by art.

422. *Culture.*—The seed should be sown in the latter end of March in a pot, which must be placed in a melon-frame; the seedling plants, while small, should be set out singly in small pots, and kept, under the shelter of a cold frame, until about the twentieth of May, when the mildness of the season will probably allow of their being planted out, without risk of their being killed by frost. At that time, a bed must be prepared for the reception of the plants, by forming a trench two feet wide, and one foot deep, which must be filled level to the surface with rotten dung from an old cucumber bed; the dung must be covered with six inches of garden mould, thus creating an elevated ridge in the middle of the bed, the sides of which must extend three feet from the centre. The plants must be put out three feet apart; I planted mine at only two feet distance from each other, but they were too near. In five or six weeks from the planting, their branches will have grown sufficiently to allow the gathering of the leaves for use. In dry seasons, the plants will probably require a good supply of water. They put forth their branches vigorously as soon as they have taken to the ground, and extend, before the end of the season, three feet on each side from the centre of the bed.

"In gathering for use, the young leaves must be pinched off branches, taking care to leave the leading shoot uninjured; with the smaller branches which subsequently arise from the sides the leaves which have been gathered, will produce a supply in the late period of the year; for the plants are sufficiently hardy to stand the frosts which kill nasturtiums, potatoes, and such vegetables."—(ANDERSON, in *Hort. Trans.*, Vol. IV. 492.)

## PART II.

OPERATIONS IN THE VEGETABLE GARDEN FOR THE  
MONTH OF AUGUST.

423. *Sow*—Winter spinach—the prickly seeded (419), in the first and second week.

Cabbage-seed, early York, sugar loaf, Fulham (111), for the main summer supply,—in the first week.

Onions, to come in about the end of March,—not later than the second week.

Radish (352), for autumnal use,—two or three times in the month.

Lettuce (485), the white Cos, brown Bath, or Capuchin, for late autumnal supply, or to be transplanted next month to stand the winter:—sow some early.

Cauliflower,—between the twentieth day, and the close, as per Ball's method (120).

*Plant*—Slips of lavender, rue, rosemary, sage, hyssop, and marjoram.

*Transplant*—Broccoli, at the beginning, and again at the end of the month, for early and later spring use (124).

Cabbage (110), Savoy (116), for use in November and December.

Brussels sprouts (117), Borecole (118):—all these at the commencement, and again towards the end of the month.

Celery (359), into trenches for blanching; once or twice: water it.

Endive, a full crop (489), in the second, and again in the fourth week.

*Cut* all sorts of sweet herbs, and aromatic and bitter plants for drying—choose a dry time, when they approach to full blossom.

*Gather* seed-capsules, or pods, as they ripen, and dry them in an airy situation.

*Cut down* artichoke stems as the fruit is taken; remove suckers from the plants, if it be desirable to have very large heads.

*Earth up*—in dry weather, the celery plants in the trenches, and repeat the earthing two or three times during the month.

*Destroy weeds* every where, remove litter, and attend to neatness and order.

## SECTION III.

## NATURAL HISTORY AND CULTIVATION OF BERRY-BEARING SHRUBS.

The CURRANT:—*Ribes*; *Grossularæ*. Class v. Order i. *Pentandria Monogynia*, of Linnæus.

424. The essential generic character of the genus *Ribes*—which includes all the numerous varieties of the currant and gooseberry—according to the last edition of Sir J. E. SMITH'S *English Flora*, is, “Berry with many seeds. *Calyx* bearing the petals. *Style* divided. *Flower* of five-petals superior.”

Subject 1. *Ribes rubrum*.—The red and white currant is thus described. “No prickles; clusters smooth, pendulous; flowers but slightly concave: petals inversely heart-shaped. In mountainous woods, especially about the banks of rivers in the north of England and Scotland. Berries globular, red, and shining, each crowned with the withered flower:—in *gardens*, either red, white or flesh-coloured.”

Subject 2. *Ribes nigrum*.—The black currant. “No prickles; clusters hairy, pendulous, with a separate flower-stalk at the base of each; flower oblong. In sandy swamps and thickets, about the banks of rivers, in Cambridgeshire, Bedfordshire, Warwickshire, Cumberland, and Essex. In Costesy island, near Norwich; between Norwich and Yarmouth, by the river in several places, and also in Scotland. Berries large, globular, black, gratefully subacid, with some flavour of the leaves.”

Subject 3. *Ribes grossularia*.—The common gooseberry.—“Prickles, one, two, or three, under each bud: branches otherwise smooth, spreading: stalks single-flowered: bractæ close together: segments of the calyx reflexed, shorter than the tube. In woods and hedges about Darlington, plentiful. Apparently indigenous in Hamilton woods, Scotland. Berry elliptic oblong, or nearly globular, green or yellow, rough with scattered hairs.”—(*English Flora*.)

425. *Varieties of the Red Currant*.—The *Encyclopædia of Gardening* mentions ten varieties, namely,—

Common red or white,	Champagne pale red,	White crystal,
Large red,	White Dutch,	Large pale red Dutch,
Long clustered red,	Large new white	Gooseberry-leaved.
Champagne large red,	Dutch,	

426. *Propagation*.—Currant-trees are raised from seed, by cuttings, and by suckers. The first method, by seed, includes all those

scientific processes by which new and improved varieties are obtained, and is peculiarly applicable to the *white* currant, which, in general, is far less productive of young vigorous shoots than the red currant, and hence, cannot be so quickly multiplied by cuttings as that shrub is. The second method, by cuttings, is the one almost universally adopted, and that by which approved varieties are continued. The third method, by suckers, is certain in its results, but is objected to by some, because it is supposed that the shrubs so raised, are very apt to produce abundance of suckers from their roots.

(1.) *By seed*.—With a view of obtaining improved sorts, “that indefatigable horticulturalist, Mr. Knight, procured cuttings in the year 1810, of the finest varieties of the red and white currant, which he planted in pots of very rich mould, and placed under a south wall, to which the trees were subsequently trained. At the end of three years, within which period the pots had been as often changed, the trees were first suffered to produce blossoms. These were, with the exception of a very small number, removed from the white currant trees as soon as their buds unfolded, and those which remained were deprived of their stamens whilst immature, and subsequently fertilized by the pollen of the red variety. The seeds thus obtained were sown in pots as soon as the fruit had become perfectly mature, and were subjected early in the ensuing spring, to the artificial heat of a forcing-house; by which means, and by proper subsequent attention, the plants grew more than a foot in height in the first season. At two years old, in the year 1816, several of the plants, and in 1817, the greater part of them, produced fruit of a great variety of character and merit; but out of about two hundred varieties, only three red and two white appeared to possess greater merits than their parents.” (*Hort. Trans.* III. 88.) From these experiments resulted, *Knight’s crystal currant*, one of the finest varieties known.

(2.) *By cuttings*.—“Plant cuttings” (in October);—“this is an expeditious and plenteous method of propagating these shrubs. In choosing the cuttings, let it be observed they must be shoots of the last summer’s production. Let them be taken from healthy trees, and such as are remarkable, according to their kinds, for bearing the finest fruit. Having procured such cuttings, let each be shortened from about eight to twelve, or fifteen to eighteen inches long, according to its strength; and plant them in a shady border. Let them be planted in rows crossways to the border, allowing ten or twelve inches between row and row, and put every cutting near half way into the earth.”

In planting these, and all other cuttings, care should be taken to

press the earth very firmly to the heel, otherwise not one in five will succeed. If the contact of the soil and wood be close, roots will be readily protruded, and then one or two buds within the soil, and as many above it, will form as fine a plant as if eight or ten had been left to sprout. A long cutting, in fact, is less likely to succeed than a short one, and it will be easy to obliterate any supernumerary shoots so as to leave but one stem to support a well-formed head. February is a very good season for this work, because the cuttings will not then be liable to decay, and will push out roots at the same time that the descending current is propelled downwards by the peculiar agency of light, which, acting by induction, produces the flow of the sap, and the developement of the germs or buds in early spring.

(3.) *By suckers*.—"These shrubs may also be propagated by suckers from the root; which may be taken up with roots, and planted; the strongest, at once where they are to remain, and the rest in nursery rows for a year or two, &c."—(ABERCROMBIE, in MAWE'S *Calend.*, Oct.)

*Cuttings* of the semi-ripe wood, with or without a heel of the older wood, will succeed equally well if planted during August in a very shady situation, provided that the soil be retained in a moist condition.

427. *Mode of rearing and methods of pruning*.—The currant-tree bears fruit on the young wood of two or three years' growth; also on short natural spurs along the branches of the older wood, and on such as have been artificially produced by skilful and judicious pruning. There are two principal methods of pruning the currant, which are productive of very different results. The one is that which, for the sake of distinction, I shall designate *the long pruning*; the other, that which produces fruit in masses, chiefly on artificially formed spurs: this method may, therefore, with propriety be termed *spur pruning*. The first method I shall endeavour to render perfectly intelligible by combining the directions of Abercrombie with those of Mr. Charles Harrison, the late gardener of Lord Wharnccliffe.

(1.) *Long pruning*, for producing an equal distribution of racemes, or fruit-bunches, all over the bearing branches. Abercrombie says:—"In pruning these shrubs, it will be necessary to observe that their branches should be kept thin, and at regular distances. The heart of the trees should be open, and clear of wood, so as to admit the sun and air in summer to the fruit, and the branches no where suffered to cross one another. Numbers of young shoots are produced every summer, many of which should now be cut out; but, in doing this, occasionally leave here and there one or more of the

best placed and most regular grown of the said shoots towards the lower part of the trees, but particularly in places where there is a vacancy; or for a succession of young bearing wood, to supply the places of such branches as are grown too long or straggling, and such branches that are worn out, or become past bearing good fruit, which should be entirely removed or cut shorter, in order to make proper room for such young shoots as promise to produce the best fruit. All such shoots as are not wanted must be cut close to the branches. The shoots and branches, in general, should stand, at their extremities, eight or nine inches distant from one another.

As almost every branch will have produced three, four, or more, of the said young shoots last summer; that is, one at the end, and the rest placed under another, lower on the branch, you are to observe that, except in vacancies, it is not necessary that there be more than one or two of these young shoots left on each of the general branches; one of which must be left so as to terminate, and be a leader for the branch, and the others, only left below in vacancies; or, if not wanted, cut quite out. Let it be observed in pruning these shrubs, that the summer's shoots should be very little shortened. Some cut the shoots very short, but that is wrong, for it fills the trees next summer with numberless useless shoots, to the great prejudice of the fruit. To avoid this, let the shoots be always shortened with discretion; never cut more off an ordinary shoot than about one-third of its length, and about one-fourth of a vigorous shoot. But this shortening should not be general, but practised occasionally; for instance, if the shoot advance much beyond the rest, or if it turn its end down to the ground, as gooseberries often do."—(See MAWE'S *Calendar*, October.)

"In pruning the currant-tree," says Harrison, "always endeavour to keep a plentiful supply of young vigorous wood, as the fruit is much finer when produced from such, than from short spurs. In order to obtain suitable wood, it is necessary to cut out a certain quantity of the old wood every year; and with the exception of the main limbs, let no wood be retained that is more than four years old. The main limbs of the tree must always be disposed at a proper distance from each other, so that the bearing wood may not be crowded. The shoots retained must be left about four inches apart, and their ends be cut off; strong vigorous shoots must have about three inches cut off the end, and less vigorous ones in proportion. Always use a knife for pruning the trees, and not a pair of garden shears, as is generally practised."—(*Treatise on Fruit Trees*, 1826.)

The reader will perceive that in the foregoing methods of pruning, artificial spurring is not aimed at, but a succession of young

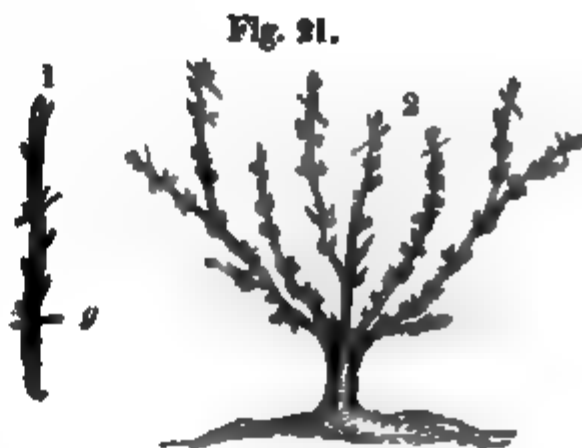
bearing wood is provided for, by cutting out, every three or four years, the old bearers, and retaining well-placed wood, which is to be shortened but little, if at all; and that only, according to Abercrombie, when any portion of it advances beyond the rest, so as to produce irregularity in the growth and appearance. Currant-bushes, so pruned, will be inclined to have their fruit distributed in regular order throughout the whole length of the bearing wood, that has attained sufficient maturity to protrude, in the autumn, those short natural spurs or fruit-buds, with which these shrubs abound:—a very different result will be produced by practising—

(2.) *The spur method of pruning.*—This is the method of the market gardeners, by which such prodigious quantities of fine fruit are provided for the London markets; and it is thus described by Mr. Cobbett, with his usual perspicuity, at No. 267, of his *English Gardener*.

“ When the young currant-tree is planted out, it ought not to be suffered to have any limbs within five or six inches of the ground; but should be made to have a clear and straight trunk to that height. When the limbs come out, or rather the shoots that are to become limbs, there should not be more than four or six suffered to go on as principal limbs. By shortening the shoots at the end of the first year, you double the number of limbs. These are to be kept constantly clear of side shoots, by cutting off, every winter, the last summer's wood, within one bud or two of the limb; and when the limbs have attained their proper length, the shoot at the end of each limb should also be annually cut off, so that the tree, when it has received its pruning, consists of a certain number of limbs, looking like so many rugged sticks, with bunches of spurs sticking out of them. On these spurs comes the fruit in quantities prodigious. If you neglect to prune in the manner here directed, the centre of the tree becomes crowded with wood, and the small quantity of fruit that comes near the point of the limbs is very poor and small. (This method of pruning currants is amongst the very greatest improvements in gardening, and is a discovery to be ascribed solely to the market gardeners in the neighbourhood of London, like a great many other things in the art of gardening, in which they far excel all the rest of the world. Mr. Marshall, in his book on gardening, and the French authors, in all their books, describe a method very different indeed from this, which is, at once, so simple and so efficacious, causing to be produced such immense quantities of fruit, and always of the best quality:—hanging to one single joint of a currant tree, in the market gardens, you frequently see as much fruit as would fill a plate. One tree pruned in this manner is equal to

more than six trees pruned in the manner practised in general throughout the country. But these gardeners excel all the world in every thing that they undertake to cultivate: they beat all the gentlemen's gardeners in the kingdom: nothing ever fails that depends upon their skill."

Fig. 21.—1. Shows a cutting of the currant-tree; the part below the lower cross-mark, *g*, should be planted in the soil, the buds, except the lowest, being previously taken off: the buds also between the two marks should be removed. But those above the sloping mark are to be left on; the top of the shoot being cut off in a slanting direction upwards, above the uppermost bud.



2. Represents the currant-tree pruned according to the *spur* method, described above.

The tops of every shoot are to be pruned off by a sloping cut above a bud, as indicated by the marks across their terminations.

M'Phael says, and his directions apply to the *gooseberry* as well as to the currant-tree:—"In pruning the first two or three years after planting, head down the young shoots pretty close, leaving them longer and longer every time of pruning, as the plants gather strength, forming the branches out every way regularly to the height of three or four feet, leaving the bearers from six to ten inches apart. These bushes require a regular annual pruning; and as they produce fruit on the preceding year's wood as well as on *studs*, the best and speediest way to prune them is, with the left hand to lay hold of the branches that are appropriated for bearing the fruit, one after another, and, with the knife in the right hand, begin nearest the ground, and cut off quickly *all the last year's lateral shoots, leaving only an eye or two on each*, taking care not to injure the spurs; and shorten the young leading shoot of each bearer to a third of its length, or more, or less, according to the strength of the bearing branches in general. Currants shoot more luxuriantly than gooseberries, therefore their shoots require to be more shortened, and the bush let run to a greater height."—(*Gard. Rem.*—'Gooseberry,' &c.)

Currant-trees are trained as dwarf standards, in the fan shape, without support: to effect this, prune off all the foreright and back shoots, so as to give the bushes a flattened form. For *espalier*, or

*weill-trees*, train them with a low stem, branching in the fan form, tying or nailing them to rails, or against the wall; or lead two branches horizontally against the rail or wall, half a foot above the ground. Remove all the buds situated on the under side of the two horizontals: then the young shoots that advance on the upper side of the branches are to be trained at the distances of five or six inches from each other, in a perpendicular direction: these must be pruned regularly, by one or other of the methods of pruning just described, according to the fancy of the cultivator.

428. *Summer pruning*.—"In May or June, cut out close the most irregular shoots rising in the centre of the tree, with all cross and water-shoots\*, to admit more freely the essential influence of the air and sun, and promote the growth of the fruit and improve its flavour. Also twist off all root-suckers as they appear†."

429. *Insects, &c.*—"The red currant is occasionally attacked by the caterpillar (*Phalæna grossularia*), and very frequently by the *Aphides ribis* (familiarily termed the *honey-dew*): the insect appears to me to be enticed by the *saccharine* process which is induced by frosts, after the first expansion of the leaves: the juices thereby are rendered sweet, the leaves become the prey of the aphides, and these, in their turn, deposit a saccharine, honey-like excrementitious substance, which is known as the honey-dew. These insects change the colour of the leaves by producing red pits and puckers on them; they also cause the fruit to be shrivelled and flavourless‡." They are, it is said, to be destroyed by watering with lime-water, and water alone; but I believe that little reliance is to be placed upon these remedies. The liquid sulphurate of lime—the clear, yellow liquor floating upon the preparation so frequently named and referred to (see No. 49), if it were rather more diluted, and suffered to deposit its sediment, would, I think, be in every way more

\* By the term *water-shoots*, in either the *currant* or *gooseberry*, is to be understood, those thick, straight, succulent shoots, with fewer and more distant leaves, which arise from the bottom of the trees in almost a perpendicular direction. In the *gooseberry*, they are often covered with a profusion of bristly spines, totally unlike the regular thorns of the fruit-bearing branches.

† I am persuaded that, in pruning by the spur method, the work should be begun in July; for the fruit-buds begin at that period to be very visible. If the young side-shoots were then cut down to one inch, a great deal of injurious shading would be prevented, and, I believe, the number of fruit-buds would be prodigiously increased.

‡ Were further proof needed of the vital importance of the leaves to the due elaboration of the juices, it would be afforded by the mischievous effects produced by the ravages of the aphides; for, not only is the fruit of an infested tree rendered defective in flavour, but the tree itself is very often considerably injured.

effectual, than simple lime-water. Strong tobacco-water may be used with effect. *Tobacco* is of very easy cultivation.

430. *Taking the fruit, and preserving it on the trees.*—"The ripening fruit comes in for small gatherings in June, advances to maturity in July, and continues in perfection till the end of August: or if trees in a full exposure are timely defended from birds and the full sun with garden mats, or protected with nets where they grow against a north wall, the fruit may be continued good till September or October. Gather in a dry state, as in rainy weather they lose their flavour."—(ABERCROMBIE.)

Forsyth says,—“As currants are very liable to be devoured by earwigs which take shelter under their leaves and branches, bundles of bean-stalks should be hung up some time before the bushes are covered with mats or nets. If proper attention be not paid to this, the fruit will generally suffer very much from these insects. After the bushes are covered, take the mats off once in three or four days, and kill the earwigs that have got into the bean-stalks, which it will be necessary still to keep hung up. As there is a sweetness in the inside of the bean-stalks which attracts the earwigs, they very readily take shelter in them from rain.”—(*Encyclopædia of Gardening*, No. 4692, 3, and 4.)

431. The BLACK CURRANT is propagated by cuttings, &c.; and little need be said on the culture of this shrub, as it in most respects is the same as that of the red currant. It bears its fruit chiefly on short spurs, and on the young wood of the preceding year, but is not pruned so closely as the red currant. Some, indeed, do not shorten the shoots at all, but cut clean out all the old and decaying wood, leaving the younger branches to supply its place. The tree does not appear in any sort of soil, to be of long duration; and therefore it is always best to provide a constant succession, by planting cuttings every year, in October, November, or February. They strike freely, and soon come into bearing.

432. *Soil and Situation.*—A moist soft soil, a shady situation with regard to the sun, but still open and not crowded with other trees, suit the black currant the best. It may be planted in rows by the sides of shady borders, or in a plot of ground exposed chiefly to a north aspect. Neill observes that it bears most fruit as a standard, but the largest berries when trained to a wall.

433. The GOOSEBERRY, as may be seen at No. 424, is a native of England. In the *Encyclopædia of Gardening*, it is said to be “naturalized in various places, on old walls, ruins, and in the woods and hedges about Darlington. It is cultivated in greater perfection in Lancashire than in any other part of Britain; and next to Lan-

cashire, the climate and treatment of the Lothians seem to suit this fruit. In Spain and Italy the fruit is scarcely known; in France it is neglected, and little esteemed. In some parts of Germany and Holland, the moderate temperature and humidity of the climate seem to suit the fruit; but in no country is its size and beauty to be compared with that produced in Lancashire, or from the Lancashire varieties cultivated with care in the more temperate and humid districts of England."

Gooseberries, in the green state, can be preserved throughout the winter by several methods—one is, to fill the bottles with water, by which means the air is excluded; and, indeed, the exclusion of air is the sole object; but water is a bad medium to preserve the gooseberries in, on account of its tendency to effect decomposition. Another method is, to place the bottles, filled with the berries and then corked, in water, which is gradually brought to boiling; but it would be much safer to leave the bottles uncorked, and, after the boiling had been continued for a few minutes, to bung them tight; or to tie over the neck of each, a strong wet bladder, while the ebullition continued; there would then be little danger of bursting the bottles, or of blowing off the coverings, and the air would be equally expelled.

434. *Varieties*.—"The gooseberry is mentioned by Tusser, in 1573. Parkinson enumerates eight varieties; the small, great, and long common, three red, one blue, and one green." PARKINSON'S *Herbal—Theatrum Botanicum*, was published in 1640. "Miller only says, there are several varieties obtained from seed, most of them named from the persons who raised them; but as there are frequently new ones obtained, it is needless to enumerate them."—MILLER'S *Gardener's Dictionary* was first printed 1731. "The present lists of the London nurserymen contain from eighty to one hundred names; but those of some of the Lancashire growers, above three hundred. G. Lindley's catalogue contains 722 varieties! Forsyth, in 1800, mentions ten sorts as common; and adds a list of forty-three sorts grown in Manchester. The following may be considered established varieties, and such as merit cultivation:—

<i>Red.</i>	Red champagne,	Green Pitmaston,
Old ironmonger,	Nutmeg,	White Smith.
Early black,	Captain,	<i>Yellow.</i>
Damson, or dark red,	Wilmot's early.	Great amber,
Large rough red,	<i>Green.</i>	Globe amber,
Red walnut,	Green Gascoigne,	Great mogul,
Warrington,	" Walnut,	Hairy globe,
Smooth red,	" Globe,	Golden drop,
Hairy red,	" Gage,	Honeycomb,

Sulphur,  
Conqueror,  
Yellow champagne,  
Golden knap,

Royal sovereign,  
Tawny.  
*White.*  
Large crystal,

White veined,  
Royal George,  
White Dutch,  
„ Walnut."

(*Encyc. of Gardening.*)

"Neill observes, that although the large gooseberries make a fine appearance on the table, they are often deficient in flavour when compared with some of the smaller size. Many of them have very thick strong skins, and are not eatable unless thoroughly ripened. Some of them, however, are of very good quality, such as the red champagne and the green walnut. Among these also, Wilmot's early red deserves further notice. It was raised by Wilmot, of Isleworth, in 1804," is "early ripe, of excellent flavour, and very productive."—(See *Idem*, 4637.)

Mr. Cobbett says,—“The following is the list cultivated in the king's gardens: *Claret, Early Lincoln, Golden drop, Goliah, Greengage, Imperial, Keen's seedling, Lomax's victory, Old Briton, Pope, Rumbullion, Warrington*. For many years it has been the fashion to give the preference to gooseberries of very large size, and the people of Lancashire (chiefly the weavers) have been famous for their success in this way; but as quality is far preferable to size, I regret the almost total disappearance of the little smooth black gooseberry, and of the little hairy red gooseberry, both of which have very thin skins, and are of delicious flavour. The big gooseberries are nearly all skin, and the pulp is of a very mean flavour. For several years I have not seen a black gooseberry-tree in any garden except that of some old farm-house; but I would earnestly recommend to the reader to obtain these two sorts if he can.” (*English Gardener*, No. 270.)

They to whom the recollection of the middle sized rough *red*, rough *green*, and *amber* gooseberries is familiar, will, I think, justify the assertion, that few of the varieties, whether they be large or small, rough or smooth, have ever equalled these excellent gooseberries in delicacy of texture or richness of flavour. While writing on the quality of this fruit, I would suggest, as matter for inquiry, that it abounds with *sulphur*; or, if it do not actually contain sulphur, that it possesses the property of developing it when in contact with the saliva of the mouth. I have very frequently remarked a strong sulphureous odour passing over the internal organ of smelling; which organ is, in fact, the real distinctive agent of taste and flavour, and have mentioned the circumstance to others. If my conjecture be well grounded, the fact of the developement of

sulphur, or of its previous existence in the gooseberry, will add force to Sir Humphry Davy's hypothesis of the compound nature of sulphur, alluded to at No. 103 of the section on Water; and also to the theory of the aqueous origin of all substances containing *carbon* and *hydrogen*.—(See 103—*b*.)

435. *Propagation, soil, &c.*—The gooseberry, as well as the currant-tree, is produced from seeds, by suckers, and by cuttings; therefore, the directions for raising the currant-tree, given at No. 426, will apply to the gooseberry. This shrub will thrive best in a rich and mellow soil; particularly if it be soft and moist, and situated on a dry bottom. The fruit is produced from small snags or spurs along the branches of the two or three years' old wood; and also from buds of the wood of the preceding year; hence, the object of the pruner should be to produce as many fruit-spurs as possible on all the wood he intends to retain. In the formation of the tree from a cutting, it will be requisite to cut back the shoots of the first summer's growth, just before the new buds break, to within one or two buds of the main stem. If these, so left, push regularly, about eight should be permitted to grow, to form the head; they ought to be so situated as to produce a pretty regular figure, by the shoots branching out at an oblique angle, and not upright from the centre. The eight shoots will require pruning to half their length, in the February following; and then, if soil and situation be favourable, the tree may be considered as formed.

Forsyth, speaking of the final planting out of young trees (which should be performed at any time between October and April), says—"The market-gardeners about London, plant them in rows, from eight to ten feet apart from row to row, and six feet from plant to plant in the rows. In small gardens I would recommend planting them in a compartment by themselves, at a distance of six feet between the rows, and four feet from plant to plant; or you may plant them round the edges of the compartments about three feet from the path; you will then have the ground clear for cropping, and a man, by setting a foot on the border, can gather the gooseberries without injuring the crop."

*Neill* mentions a method of training gooseberry trees to one single tall stem, tied to a stake:—"This," he says, "though six or eight feet high, occasions scarcely any shade on the border; and it does not occupy much room, nor exclude air; while, at the same time, the stem becomes close hung with berries, and makes a pleasant appearance in that state."—(*Encyc. of Gard.*, No. 4644—from *Edinb. Enc.*) This training can only be effected by keeping the lateral shoots constantly spurred, and not suffering one of these

laterals to extend beyond two or three inches, removing altogether, from time to time, all such spurs as become old or deformed.

436. *General culture of the gooseberry.*—The following are some of Harrison's directions. "Gooseberry-trees like a good deep strong loamy soil, and almost any airy situation is suitable for them; but the crop is most abundant when the situation is favourable to their protection in spring from the cold east winds, which are frequently destructive to the blossom of those trees. In planting the trees, always spread the roots regularly round the hole, and at four inches from the surface; let the tree be mulched immediately after being planted.

"The trees afterwards require a summer and winter regulation. In furnishing the tree with wood, let the bearing shoots be six inches apart. The *summer* regulation must be performed about the end of June, or early in July, in doing which, let any luxuriant shoots be taken away, also all suckers which may be arising. It is a practice with some persons, at this season of the year, to pinch off the ends of all shoots upon the tree; but I disapprove of it as a general practice, because I have had ample proof that it causes the tree to send forth a great number of useless shoots, and thus its strength is thrown away.

"There is also another injury done to the tree at the early part of the season by the gathering of the fruit when it is green, and before it has attained half the size it would have done. In doing this, some persons clear whole trees of the berries which were upon them; the effect of which is, that the trees being so suddenly deprived of their produce, receive a very severe check, and the superabundance of sap is expended in a great production of suckers and luxuriant shoots: thus their strength is thrown away and the trees greatly injured. Instead of this, I always thin off the berries from every tree, and thus the fruit which remains is improved in size, and the object of a supply of green gooseberries is obtained, whilst a proper reserve is left for ripening. If it be desired to have very large fruit, it may be obtained by a judicious thinning, shading of the fruit from hot sun, and, when the fruit approaches maturity, from rain; also, by watering the roots with manure-water. The water which I use is three quarts of drainings from a dunghill to one quart drained from fowls' or pigeons' dung, soaked for the purpose, which must be applied so as to keep the soil in a moist condition. Let manure-water be used twice, and pure water once, in regular succession."

437. *The Winter pruning* is usually performed before Christmas, or directly after the first frost, but the practice is founded in error.

Pruning of every tree or shrub, should, if time allow, be deferred till the buds break, for then the best shoots will be seen, and the wounds will heal. For the gooseberry and currant, this late pruning is peculiarly required, inasmuch as the tom-tits and other birds devour the buds during winter; and, therefore, the more the branches, the greater will be the chance of fruit.

*Observe.*—That the gooseberry does not bear ‘spurring’ equally well with the currant; therefore, when the tree is strong, and the branches numerous, it will always be wise to cut back every old shoot close to a new one, which is so situated as to leave the head of the tree regular. But if the displacement of any large branch would disfigure the head, it will be proper to retain it; and, therefore, during the preceding *summer* regulation, all the young shoots on it should be cut back to the eye which is above the single fruit that usually is found near its origin. If no fruit be there, the useless twigs ought to be entirely removed at the point where they emerge. The excision of crowding shoots admits air, and assists the fruit. Old wood bears weaker fruit than good new shoots, and natural spurs on these are better than artificial spurs forced by cutting weak, twiggy shoots, borne upon old branches. In this more scientific and profitable method of pruning, the fruit-branches ought not to be generally shortened, because the gooseberry is, by its nature, sufficiently inclined to produce abundance of young wood.

438. *Insects.*—“The Caledonian Horticultural Society,”—says Loudon,—“having requested information respecting the best method of preventing or destroying the caterpillar on gooseberries, received various communications on the subject.” Some of these communications are partially given; but he declares his own opinion to be “that no reliance is to be placed on hot lime alone—that hot water, lime-water, and digging deeply down may be useful;” but the only effectual plan seems to be that of previously hand picking. At No. 246, I have stated the result of an actual experiment: to that paragraph I therefore refer the reader: adding, that I think it might be advisable to combine several plans of prevention recommended by different writers: thus, Harrison’s plan of manuring in winter might be improved by sprinkling a handful of salt with the manure; the stems of the trees, after pruning, being washed with lime-water or strong soap-suds. *Lime*, I think, will not destroy the larvæ of the *tenthredo*, and such is the opinion of farmers and others who have tried it. *Aloes*, in solution, might be as effectual as the *colocynth*, but I have had no occasion to bring it to the proof.

## PART II.

## OPERATIONS IN THE FRUIT DEPARTMENT.

439. Look over the vines, and stop or pinch off the shoots about two buds above the fruit: regulate the summer shoots of the peach and nectarine trees; and destroy wasps, by suspending phials half filled with treacle and water, among the branches.

The trees also may be protected by nets. If the weather be very dry and parching, an occasional watering to the extent of three or four gallons, over the soil around the stems and over the roots of these trees, would be of great service: soft pond water, with a table-spoonful of common salt, or of salt-petre, in solution with every two gallons, could serve in the place of manure water.

Hoe, rake the surface, and remove litter of every kind from the fruit-borders; and keep every part of the fruit-garden, or compartments, neat, and free from weeds.

## MISCELLANEOUS.

440. *Sow*—the seeds of bulbous plants,—tulips, hyacinths, irises, crown imperials:—sow also, anemone, ranunculus, mignonette, and turricula seeds, in pots and boxes.

*Plant*—Autumnal flowering bulbs, and herbaceous plants,—the sweetwilliam, dianthus, wall-flower, scabious, stock, and many other sorts of perennials.

Clip box edgings, and hedges of all kinds, as thorn, holly, hornbeam, privet, elm, beech, and yew.

Attend to the flower-borders; keep them clean by weeding, lightly raking the soil, and removing decaying flower-stems.

Gather and preserve seeds, and carefully mark each several sort.

441. *Selection of Shrubs and Plants which flower in August.*—*Deciduous Shrubs.*—Roses—the Chinese and several others, *Rosa muscosa*, &c.; althæa frutex, *Hibiscus syriacus*; shrubby cinquefoil, *Centilla floribunda*; Passion-flower, *Passiflora corulea*, *Salvia*, *Helianthus*.

*Evergreen Shrubs.*—Ever-blooming rose, *Rosa semperflorens*; *Myrica*, several species; *Gerania* and *Pelargonium*, many varieties—and of them admirable subjects for the parterre.

*Herbaceous Plants.*—American Groundsel, *Senecio elegans*; *Marigold*, *Tagetes*; *Peru*, *Mirabilis*; Cardinal flower, *Lobelia cardinalis*; Pinks and Carnations, numerous varieties, *Dianthus*; sweet and yellow

Sultan, *Centaurea moschata et suaveolens*; Ladies' traces, *Neottia spiralis*; *Calliopsis*, various, *C. tinctoria*, *minima*, *atrosanguinea*, &c.; *Campanula*.  
 Bulbous Rooted.—Meadow Saffron, *Colchicum autumnale*; Belladonna lily, *Lilium belladonna*; Guernsey lily, *Lilium sarniense*.

## THE NATURALISTS' CALENDAR.

### AUGUST.

THE heat is but little reduced: in general, though not without exception, the highest temperature is found to exist when easterly winds prevail. The mean quantity of rain is calculated at more than one inch less than that which falls during the preceding month; hence August is a drier month than July; and this circumstance, connected with the usual serenity of the weather, renders it one of the sweetest months of the whole year.

The average height of the Barometer is about 29 Inches, 90 cts.  
 Ditto of the Thermometer, about 63 Deg.

*In the first week.*—The swallow-tailed butterfly (*Papiliomachæ*) is seen; the horse fly (*Oestrus bovis*) deposits its eggs on horses.  
*Second week.*—Young broods of goldfinches (*Fringilla carduelis*) (Hirundo apus) departs.  
 ... resume their spring notes; lap-  
 ... butterfly (I

# SEPTEMBER.

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## SECTION I.

### SCIENCE OF GARDENING.

#### CONSTRUCTION OF A GARDEN.

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#### PART I.

##### OBJECT AND IMPORTANCE OF GARDENING.

WHILE I agree with the author of the *Encyclopædia of Gardening*, that the object of horticulture “is to cultivate products used in domestic economy,” and that “it includes culinary and fruit-gardening, or orcharding; and forcing, or exotic gardening, as far as respects useful products,”—I cannot but consider that it is, in fact, much more noble, for it includes pursuits which can scarcely fail to enlarge the understanding and improve the heart, while they tend to fortify the constitution, and establish the health.

*Domestic gardening* is frequently believed to be a source of expense rather than a means of economy, and where many hired hands are employed, it cannot be otherwise. Gardening is, indeed, very costly to the noble and affluent; to those who require and possess all the luxuries of the art; and who shall find fault with the expenditure of wealth, however great in its extent, when its result is the remuneration of meritorious men, for the skill and labour they exert in the cultivation of the delicious fruits of the hot-house, and the choicest specimens of the Flora of other climates?

But domestic gardening need not be a source of loss, or of unrequited expenditure; it may be rendered one of profit, provided its operations be conducted with prudence, and upon sound philosophical principles; and if I succeed in proving, by documents worthy of attention, that the garden may be made to produce a supply for the cow, the piggery, and the poultry-yard, after furnishing an abundance of every description of vegetables for the use of the family, as well as more or less surplus stock of fruits, &c., which

can be converted into actual money; if I do this, it will not be denied that gardening, as a scientific pursuit, is highly deserving of the attention of persons with limited incomes, whose object it is to render what they possess, available to the permanent advantage of their families.

To render this treatise as simple, yet as systematic as possible, I assume the case of a man who has invested a few hundred pounds in the purchase of a dwelling, and four or five acres of land, whereon to form a domestic homestead. On this land there is no available garden; he, therefore, is obliged to construct one. Now, to do this to advantage, he must become acquainted with the nature of the soil, the proper method of obtaining protection and shelter, the extent of the ground required, and the probable expenses of the whole work.

In order to prevent any misconception, and consequent disappointment, it should be clearly understood, that in this way of constructing a garden, there must be considerable outlay in the first instance. The garden and its appendages must be formed on such liberal principles as to provide for *permanent* fruitfulness: it is a work designed to endure for generations; and, therefore, ought not to be stinted in the beginning. In this, as well as in almost every other undertaking of moment, it is strictly true, even to the letter, that that which is best done at the commencement, will be found to be the cheapest in the end.

By giving instructions for the performance of the work from the beginning, I conceive that I shall by no means embarrass those who possess gardens already formed, but which require re-modelling: they who know how to begin well—to lay the foundation of a new and important work, and to carry it on to its completion—are in all respects the best qualified to effect improvements, to repair, to alter, or to amend.

## PART II.

### OF THE SITUATION AND SOIL.

442. With respect to *situation*.—"Nicol and Forsyth agree in preferring a gentle declivity towards the south, a little inclining to the east, to receive the benefit of the morning sun. 'If it be situated in a bottom, the wind will have the less effect upon it; but then damps and fogs will be very prejudicial to the fruit and other crops; and if situated too high, although it will in a great measure

be free from damps and fogs, it will be exposed to the fury of the winds, to the great hurt of the trees, by breaking their branches, and blowing down their blossoms and fruit.”—(*Encyc. of Gard.*, from *Treatise on Fruit-Trees*, p. 286\*.)

443. *Some writers object to placing the kitchen-garden in front of the house.* They wish it to be altogether concealed, “as the traffic with this garden, if placed in front, is always offensive.” It may be so to many; but, surely, the domestic horticulturist cannot be induced to consider *his* garden—the chief object of his attention, care, and honest industry—as one creating disgust, and calling for concealment! He will rather incline to the opinion thus expressed, at No. 16 of the *English Gardener*—“It is most miserable taste to seek to poke away the kitchen-garden, in order to get it out of sight. If well managed, nothing is more beautiful than the kitchen-garden. The earliest blossoms come there. We shall in vain seek for flowering shrubs in March, and early in April, to equal the peaches, nectarines, apricots, and plums; late in April, we shall find nothing to equal the pear and cherry; and in May, the dwarf or espalier apple-trees are just so many immense garlands of carnations. The walks are unshaded; they are not greasy or covered with moss in the spring of the year, like those in the shrubberies. To watch the progress of the crops is by no means unentertaining to any rational creature; and the kitchen-garden gives you all this long before the ornamental part of the garden affords you any thing worth looking at.”—“In the time of fruiting, where shall we find any thing much more beautiful to behold than a tree loaded with cherries, peaches, or apricots, but particularly the two latter? It is curious enough that people decorate their chimney-pieces with imitations of these beautiful fruits, while they seem to think nothing at all of the originals hanging upon the tree, with all the elegant accompaniments of flourishing branches, buds, and leaves.”

444. *Exposure and aspect.*—It must be self-evident that, to have early fruits and vegetables in perfection, the garden should be effectually sheltered on the north-west, north, and north-east sides, and enjoy a full exposure to the south sun. If late succession crops be desirable, aspects to the east and north-west should be provided for

\* The names of Nicol and Forsyth have often occurred. Walter Nicol was a native of Scotland; he settled in England, and became gardener to the Marquis of Townshend, at Rainham-hall, Suffolk. His *Gardener's Calendar* was published at Edinburgh, in 1810. He died in March, 1811.

William Forsyth was also a Scotsman. He succeeded Miller, as Curator of Chelsea Garden, in 1769; and, in 1784, was appointed to the situation of royal gardener, at Kensington. His *Treatise on the Culture and Management of Fruit-Trees*, was published in London in 1802; and he died in 1804.

them in certain subsidiary portions of the garden. Authors differ materially in opinion concerning the aspect of the main garden; and they are not agreed as to the nature or extent of the fall or slope of the ground. The writer last quoted observes, when speaking of the aspect, that "it must absolutely be open to the south; well sheltered, if it can be, from the north and from the east; but open to the south, it must be, or you can have neither fine wall-fruit, nor early crops of garden-plants." On the subject of the *slope*, he says, that "to have the whole of a garden upon a slope, is by no means desirable; for, however gentle the slope may be, the water will run off; and, in certain cases, it is absolutely necessary that the water should not run away, but have time to soak gently into the ground. I have had great opportunity of acquiring knowledge in this respect. Part of my ground at Kensington forms a very gentle slope. The soil of this slope is as good, both at top and bottom, as any ground in the world; but I have always perceived that seeds never rise there with the same alacrity and the same vigour that they do upon the level part, though there the soil is much inferior. This is particularly the case with regard to strawberries, which will grow, blow like a garland, and even bear pretty numerous, on the side of a bank where scarcely any moisture can lodge, but which I have never seen produce large and fine fruit, except upon the level. The same may be said of almost every garden-plant and tree; and, therefore, if I could avoid it, I would always have some part of the garden not upon the slope. Slopes are excellent for early broccoli, early cabbages, winter spinage, onions to stand the winter, artichokes to come early, early peas, early beans, and various other things; but there ought to be some part of the garden upon a true level; for when the month of June comes, that is the part of the garden which will be flourishing."

445. The *exposure* should be towards the south, according to Nicol, and the *aspect* at some point between south-east and south-west, the ground sloping to these points in an easy manner. If quite flat, it seldom can be laid sufficiently dry; and if very steep, it is worked under many disadvantages. It may have a fall, however, of a foot in twenty, without being very inconvenient; but a fall of a foot in thirty is more desirable, by which the ground is sufficiently elevated, but not too much so."—(*Calendar*, p. 6.)

"An *exposure to the east*," Abercrombie observes, "is a point of capital importance in laying out a garden or orchard, on account of the early sun. When the sun can reach the garden at its rising, and continue a regular influence, increasing as the day advances, it has a gradual and most beneficial effect in dissolving the hoar frost which

the last night may have scattered over young buds, leaves, and blossoms, or setting fruit. On the contrary, when the sun is excluded from the garden till about ten in the morning, and then suddenly falls upon it with all the force derived from considerable elevation, the exposure is bad, particularly for fruit-bearing plants in the spring months: the powerful rays of heat at once melt the icy particles, and immediately acting on the moisture thus created, scald the tender blossoms, which droop, as if nipped by malignant light\*."

"An exposure in which there is a free admittance of sun and air is required by Forsyth, who rejects a place surrounded by woods, as very improper, because a foul stagnant air is very unfavourable to vegetation; and it is also observed, that blights are much more frequent in such situations, than in those that are more open and exposed."

"If there be any slope in the area of the garden, Marshall considers—"it should be southward, a point to the east or west not much signifying; but not to the north, if it can be avoided, because crops come in late, and plants do not stand the winter so well in such a situation. A garden with a northern aspect has, however, its advantages, being cooler for some summer productions, as strawberries, spring-sown cauliflowers, &c.; therefore, to have a little ground under cultivation, so situated, is desirable, especially for late succession crops.'"—*Introduction to Gardening*†.

The remark of the last writer on a *north aspect*, is of more importance than persons might be inclined to admit. Strawberries—that most valuable of our early fruits—in common with all the *berryed* shrubs, thrive best, and, in hot seasons, yield the finest fruit, on north exposures; and, though the general aspect might always be to the south, there should be shaded plots and borders, in order to enjoy in perfection a large portion of the various sorts of strawberries which come into season between the end of May and the middle of July.

The foregoing authorities are taken from the *Encyclopædia of Gardening*, Sec. I. and II., p. 455, &c. Experience has amply proved to me the correctness of Forsyth's remark on the prevalence

\* John Abercrombie, the author so often quoted, died in his 80th year, on the 30th of April, 1806, at midnight, as St. Paul's clock struck the hour. His *Practical Gardener*, from which the foregoing quotation is taken, went through several editions, one very lately. He was likewise the author of *Mawe's Calendar*.

† The Rev. Charles Marshall, Vicar of Brixworth in Northamptonshire, wrote a treatise on gardening, entitled *Introduction to the Knowledge and Practice of Gardening*; 1796. It went into several editions.

of blight in situations surrounded by woods. I believe that prevalence to be dependent on the phenomenon of conduction, effected by the proximity of innumerable vegetable points, by which the chemical constitution of the atmosphere is somewhat changed, so that the juices of the plants partake of the change, and acquire a saccharine quality. Insects are thereby enticed, but not produced; and, in every case of blight, it appears much more probable that the altered or diseased juices invite the insect, than that it is imported by this or that current of the air, whether it blow from the east, or from any other point.

446. *The Soil*.—The best soil for a garden, according to M'Phael, "is a sandy loam, not less than two feet deep; and good earth, not of a binding nature in summer, nor retentive of rain in winter, but of such a texture that it can be worked without difficulty in any season of the year.

"It should be remembered that there are few sorts of fruit-trees, or esculent vegetables, which require less depth of earth to grow in than two feet to bring them to perfection; and if the earth of the kitchen-garden be three or more feet, so much the better; for when the plants are in a state of maturity, if the roots, even of peas, spinach, kidney-beans, lettuce, &c., be minutely traced, they will be found to penetrate into the earth, in search of food, to the depth of two feet, provided the soil be of a nature that allows them. If it can be done, a garden should be made on land whose bottom is not of a springy, wet nature. If this rule can be observed, draining will not be necessary; for when land is well prepared for the growth of fruit-trees and esculent vegetables, by trenching, manuring, and digging, it is by these means brought into such a porous temperament, that the rains pass through it without being detained longer than necessary. If the land of a garden be of too strong a nature, it should be well mixed with sand, or scrapings of road, where stones have been ground to pieces by carriages."—(M'PHEAL.)

447. *A hazel-coloured loam, or blackish vegetable earth*, according to Abercrombie, "may be regarded as good; or if it be a fat loam, mixed with silvery sand, or of a moderately light, mellow loam. A bed of very light sand or gravel is to be rejected, unless the alternative would give you a soil still more difficult to improve. The worst of all soils for a kitchen-garden is a strong clay. Nevertheless, as both clay and chalk have an attraction for fluid and volatile solutions of oil, a limited proportion of those earths contributes to form a rich and generous soil."—(See the authority of Sir Humphry Davy, as quoted at No. 6 of the first section, page 10.)—"Chalk may abound in a higher proportion than clay: and sand in a higher proportion

than either clay or chalk, without causing barrenness. The soils best adapted for moderating the excesses, and compensating the deficiencies of heat and moisture in different seasons, are compositions of sand, pulverized chalk, and finely-divided clay, with a proportion of animal or vegetable matter. If the soil be not naturally good to the depth of thirty inches, and thence to three feet, proper earths and composts should be incorporated with it, in order to make it so, where the tenure does not render the expense unadvisable. It should be done where it is intended to form a complete kitchen-garden; not, indeed, because many esculent plants require more than eighteen inches depth of good earth, in order to flourish in perfection; nor that even fruit-trees, generally, will not thrive for a considerable course of time in a suitable soil full two feet in depth, although three feet on their account is better; but in order that the gardener may have it in his power to give rest to alternate portions of the soil, without keeping the surface out of crop, by trenching in successive years to different depths, so as to bring any given layer, measuring a spit in thickness, by turns to the bottom, the middle, and the surface. In proportion as the natural soil is unfavourable, it should receive improvement, till it be gradually brought to the desired state. Where something intractable must be taken away, as in the case of a very stony bed, let the ground be trenched, and the larger stones screened or raked out. Ameliorate the residue with such earths, manures, and composts, as its defects may require. To give heart to excessively light, sandy, and unstable ground, incorporate with it substantial loam and well-rotted dung."—(*Practical Gardener*, p. 2.)

418. The foregoing extracts should be compared with other authorities on the nature and chemical properties of soils, adduced in the first section, for January, pages 13, 14, and 15. The philosophy of these practical directions will thereby be rendered more apparent.

"The soil that suits general cultivation best, is a loam, rather the red than the black," Marshall observes; "but there are good soils of various colours, and this must be as it happens. The worst soil is a cold, heavy clay; and the next a light sand: a moderate clay, however, is better than a very light soil, though not so pleasant to work. If the soil is not good—*i. e.* too poor, too strong, or too light—it is to be carefully improved without delay. Let it first, at least, be thoroughly broken, and cleared of all rubbish, to a regular level depth at bottom as well as at top, so as to give about eighteen inches of working mould, if the good soil will admit of it: none that is bad should be thrown up for use, but rather moved away. This

rule of bottom-levelling is particularly necessary when there is clay below, as it will secretly hold up wet, which should not stand in any part of the garden. When a piece of ground is cleared of roots, weeds, stones, &c., it would be of advantage to have the whole thrown into two-feet wide trenches, and lie thus as long as conveniently may be. The ground cannot be too well prepared; for when this business is not performed to the bottom at first, it is often neglected, and may not be conveniently done afterwards; so it happens, that barely a spade's depth (or less) is too often thought sufficient to go on with. There is great advantage of a deep staple—that in the cultivation of it, the bottom may be brought to the top every other year by double trenching; and being thus renewed, less dung will do, and sweeter vegetables be grown. Tap-rooted things, as carrots and parsneps, require a good depth of soil.”—(*Introd. to Gard.*, p. 28.)

449. *The soil of a new garden should be two or three feet deep*, according to Forsyth; “but if deeper, the better; of a mellow, pliable nature, and of a moderate dry quality: and if the ground should have an uneven surface, by no means attempt to level it; for by that unevenness, and any little difference there may be in the quality, you will have a greater variety of soil adapted to different crops. The best soil for a garden is a rich mellow loam, and the worst, a stiff heavy clay. A light sand is also very unfit soil for a garden. Sea-coal ashes, or the cleanings of streets and ditches, will be found very proper to mix with a strong soil; and if the ground should be cold, a large quantity of coal-ashes, sea-sand, or rotten vegetables should be laid upon it, in order to meliorate and loosen the soil, and render it easy to work. Lime-rubbish, or light sandy earth, from fields and commons, will also be found of great service to stiff clayey ground. If the soil be light and warm, rotten neat's dung is the best dressing that you can give it. If horse dung be ever used, it must be completely rotted, otherwise it will burn up the crop the first hot weather.”—(*Treatise on Fruit Trees*, p. 290.)  
—(See No. 17, of the Section on *Earths and Soils*, p. 19.)

450. *A Chalky soil* is in many respects highly advantageous to garden crops. The author of the *English Gardener* remarks that—“The trees and plants which grow in a garden, prefer, like most others, the best soil that is to be found; and the best is a good fat loam at the top, with a bottom that suffers the wet gently to escape. Oak trees love clay, and the finest of that sort of timber grows on such land; but no trees that grow in a garden love clay, and they are still less fond of gravel, which always burns in summer-time, and which sucks up the manure, and carries it away out of the reach of the roots of the plants. Chalk, if it be too near to the top, is not

good, but it is better than clay or gravel, and by means of trenching, chalky soil may make a very good garden; for chalk never burns in summer, and is never wet in winter; that is to say, it never causes stagnant water. It absorbs it and retains it, until drawn upwards by the summer sun. And hence it is that the chalky downs are fresh and green, while even the meadows in the valleys are burned up, so as to be perfectly brown.

“No tree rejects chalk; chalk is not apt to produce canker in trees; and, upon the whole, it is not a bad soil for a garden, while, if it have a tolerable depth of earth on the top of it, it is, taking all things together, the pasturage, the easy cultivation of all weathers, the healthiness which it invariably gives to cattle of all sorts, the very best land in the world for a farm.”—(*English Gardener*, No. 20.)

The foregoing remarks correspond exactly with what was said on the *productiveness of soils*, at No. 6 of the section on *Earths and Soils*; to that number the reader's attention is directed, as it contains the opinion of the late Sir Humphry Davy, stated to the Board of Agriculture, in his fourth lecture—(*Elements of Agric. Chem.*)—with the result of actual observation made in the chalky district of the Isle of Thanet.

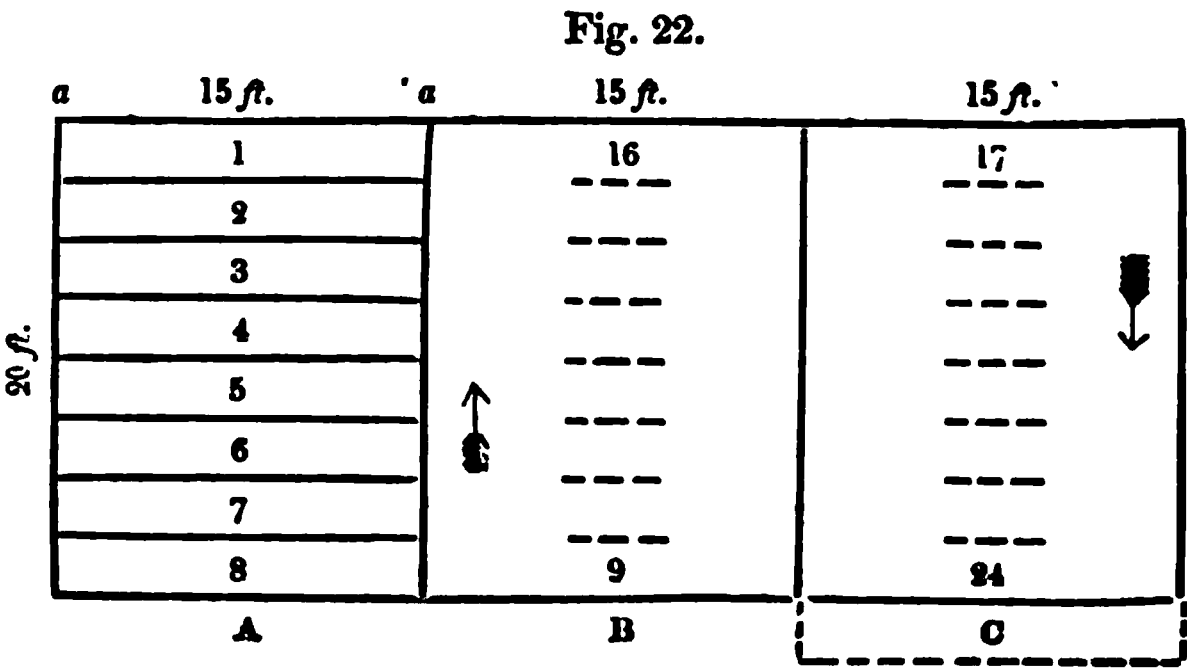
The “Analysis of Soils,” given in the *first* leading section, will materially assist the inquiring reader. It is certain that the colour and texture of soils may differ materially, without affecting their apparent productiveness; but, nevertheless, it cannot be doubted that the latter most important quality, must depend upon the power which any soil possesses to decompose and assimilate manuring substances. At this point we meet an inquiry of the last importance, and what that is, may be expressed in the form of a question:—Do earths—*native earths*—decompose all manuring substances, and reduce them to earths of the like quality, or do they not? Let us suppose a case, and it is by no means an imaginary one, of a plot of ground enclosed from an orchard, or field under grass. This plot is dugged or trenched, and the lower stratum brought to the surface, which then consists of *maiden earth*; and in this form, if the texture be sound, firm, mellow, and unctuous, a crop of broccoli plants will grow, and flourish, till they attain a size that shall exceed plants of ordinary dimensions. But continue to crop this soil, and to manure it lightly, and it will soon be manifest that the manuring substances vanish, and leave the native earth as they found it. Earths therefore tend to reduce all decomposable substances to their own earthy character; loams continue to be loams—clays, clays—and so forth, each native earth retaining its own individual constitution, neither deteriorated nor improved by cultivation.

PART III.

PREPARATION OF THE SOIL BY TRENCHING.

451. It must be laid down as a preliminary principle, which does not admit of being departed from, that the whole extent of the ground whereon a garden is to be constructed, must be pulverized and comminuted to a certain depth; and, therefore, that it must undergo a thorough and regular trenching with the spade. The philosophy of the work will form the subject of inquiry in a future part of this section; for the present, it will suffice to lay before the reader the various methods by which that operation is performed.

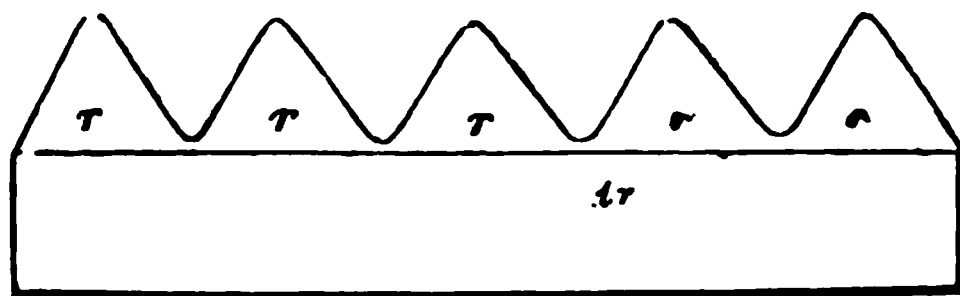
The *common method* of performing the operation is thus described by Loudon:—"For trenching, with a view to pulverizing and changing the surface, the trench is formed like the furrow in digging, but two or more times wider and deeper; the plot or piece of ground to be trenched is next marked off with the line into parallel strips of this width; and beginning at one of these, the operator digs or picks the surface stratum, and throws it into the bottom of the trench. Having completed with the shovel the removal of the surface stratum, a second, a third, or a fourth, according to the depth of the soil and other circumstances, is removed in the same way; and thus, when the operation is completed, the position of the different strata is exactly the reverse of what it was before.



452. In order to render these directions practically available, the mode of trenching is laid down in the annexed figure 22. Though drawn only upon a small scale, in order to simplify the directions, it is applicable to a piece of ground of any extent, be it greater or less. Suppose a plot of forty-five feet in length, by fifteen feet in breadth

is to be trenched—divide the ground by the line into three equal portions, A, B, C—each being fifteen feet wide. Mark the corners by sticks driven into the ground; and then either strain a line, or cut out a small drill across the top *a, a*, of the portion A. Again, divide by the line, and mark out this first portion A, into strips, each two feet wide; and begin the trenching by digging out, to the full and level depth of two feet, the earth of the first trench (1). Wheel the whole of this earth away, and deposit it along the surface of the piece of ground at c, contained within the dotted lines. There will now be an open trench two feet deep at the strip No. 1, A. Dig the surface stratum, *i. e.*, the first or upper spit of earth of No. 2, and throw it to the bottom of No. 1,—work and break it well, and then dig out the lower stratum of No. 2, to the same level depth of two feet, and place this earth on the top of the first earth thrown into No. 1, which will thus be raised considerably above the former surface-level of the ground. No. 2 will now be an open trench:—throw into it (reversing the surfaces) the earth of No. 3; and proceed in the same manner with all the remaining strips till No. 8 be the open trench. Then, mark out the portion B into eight strips, according to the dots, and begin the trenching by throwing the earth of No. 9 into the open trench No. 8. Proceed upwards to No. 16; then, mark out the portion C, and complete the work, after filling trench No. 16 with the earth out of No. 17, by working in a contrary direction down to No. 24. When that trench is empty, fill it with the earth deposited in the spare strip at c; and thus the whole of the plot of ground will be trenched, and the surfaces reversed, the earth which had been originally at top being now at the bottom of the trenches, while that which had been at the bottom is brought to the top.

Fig. 23.



453. *Abercrombie's directions for ridging and trenching* are to the following effect:—Let the trenches be marked out two feet and a half wide, and, beginning at one end of the piece, open a trench the above width, and one spade and a shovelling deep; let the earth of this trench be carried to the other end, or to that part where you intend to finish or fill up the last trench. The first trench being thus opened, mark out another; pare off, and throw the top of it, with all weeds and rubbish thereon, into the bottom of the first trench;

then dig this second trench, turning the earth of the third into it, throwing it up ridgeways, (so as somewhat to resemble, when finished, the section, fig. 23,) *tr* being the trenched ground, and *r, r, r*, the ridges. When you have dug to the end of the trench, shovel up the crumbs or loose earth, at the bottom, throwing it up upon the other; or double dig it, that is, without shovelling up the crumbs, dig the trench another spade deep, if the depth of the good soil admit, casting the earth upon that of the first spit; then proceed to a third trench, pare, and dig it as before, and so proceed with every trench to the end.—(MAWE'S *Cal.*, Oct., p. 469.)

454. These directions of Abercrombie are particularly applicable to the soil of a garden already formed; and if attended to, in conjunction with those of Judd, for the preparation of ground for the plantation of asparagus, (See April, No. 151,) will be productive of the best effects.

This double-digging, or “bastard-trenching,” as it is termed by some, is practised by the market gardeners, in order to produce the earliest and finest crops of several sorts of vegetables: plants of the *Brassica* tribe will strike and flourish in a soil so prepared with prodigious vigour.

455. *Mr. Cobbett's method of trenching.*—This author justly observes, that “according to the common method of trenching, the top soil would be turned down to the bottom of the trench, and the bottom soil brought up to the top; so that you have at top, if the land be chalky, a bed of sheer chalk; if clayey, a bed of clay, and so on; and in the very best of land you bring up to the top matter which has never seen the sun, and which, in spite of everything you can do in the way of tillage, as well as in the way of manure, will require many years before it will become ground fit to bear crops in the manner that it ought to bear them. I have taken away, sometimes, a bank which separated two fields: I have dug, manured, and done everything in my power to enrich the land on which the bank stood, but have never, in any instance, been able to make it, even at the end of several years, equal to the land adjoining it.”—(*English Gardener*, No. 23.)

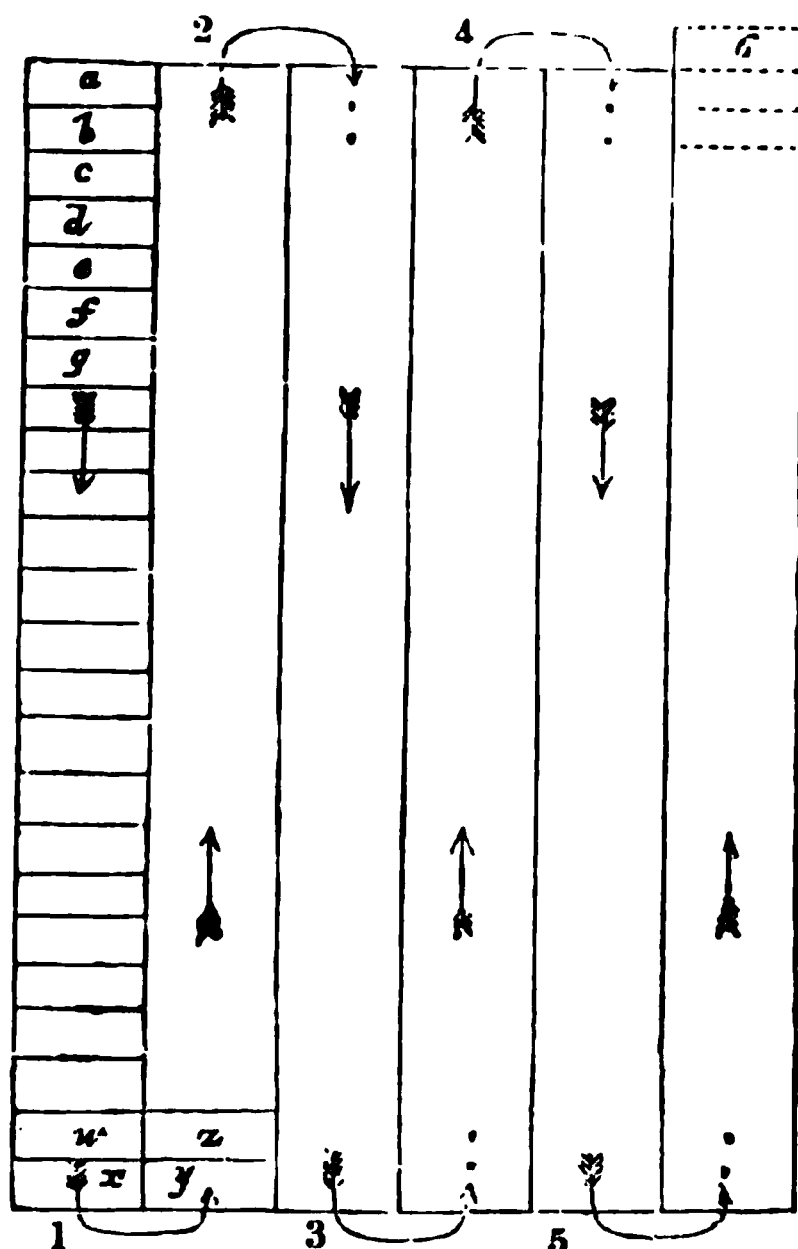
456. The method of trenching, with a view to retain the good soil at the top, may be thus described:—

Figure 24 represents a piece of land of any dimensions, the extreme limits of which are to be marked out by stakes set up at the four corners.

The operation commences by dividing the space into strips or lifts, 1, 2, 3, 4, 5, 6, each being a rod, or five yards and a half wide. This done, strain the line across the strip 1, and mark out the small

***a***, two feet wide, by chopping with the spade along the line, drive the spade straight down as deep as it will go, all round limits of the space *a*; it will cut the earth, and enable the her to bring the spits out clean, without breaking the edges.

**Fig. 24.**



top earth of *a* is now to be digged out to its full depth—suppose six inches—and wheeled away to the dotted space at 6, where it is to be placed in a round heap. Space *b* is next to be marked out, six feet wide: its top good earth digged out, and wheeled to 6, to form another round heap apart from the first. Proceed to dig out the bottom earth of *a*, to the depth of a foot at the least, or so as to make the trench two feet deep—(the author directs three feet). Wheel away this bottom earth to 6, and place it beside the two other heaps. Trench *a* is now empty; and whether it be two or three feet deep, the earth at the bottom is to be digged as deep as a spade will go, and be well moved and turned. The bottom earth is now to be digged out and put into *a*; then the space *c* is to be marked out, and its top earth thrown over the empty trench *b*, to level the surface of the trench *a*, which thus will be finished. The lower earth of *c* is to be deposited in *b*; and the upper earth of *d* is to be thrown over *c*, and placed upon *b*; and thus the work proceeds. Each trench is to be of the same depth and breadth; the bottom earth to be digged and turned, and every

trench is to be completed by receiving the top earth of the space next but one below it. On arriving at the bottom of strip 1, where the first bent arrow takes its turn, the trench  $x$  will be found empty, and the one above it,  $w$ , will be only half full; the top earth, therefore, of space  $y$ , is to be placed upon the earth in  $w$ , and the lower earth of  $y$  is to be thrown into  $x$ , which then, and with it, the strip 1, is to be finished by receiving the top earth of the space  $z$ . The reader will observe that there is some trouble in all this, and that some nicety and care are required; but, then, the case is one which demands peculiar attention, and nothing can be done without some exertion. If, however, in this mode of trenching, the course of the arrows be attentively observed, it will be found that the strips will be finished, one after the other, without difficulty, but in alternate opposite directions, till at length the last or top trench of strip 6, will be empty, and the space immediately below it will have in it only the bottom earth of the last trench. The three heaps of earth are now ready, and close at hand: throw the heap of the *bottom* earth which came out of  $a$ , into the *empty* trench, then place one of the heaps of *upper* earth upon each of the half-finished trenches, and the work will be complete.

I have proved this method of trenching, and with the assistance of a little boy, scarcely eleven years old, have trenched a piece of ground with a bad, and extremely wet sub-soil; and I therefore am prepared to assert the practicability and excellence of the method. It is, however, susceptible of improvement in two ways; the one, by manuring the surface of the *moved* sub-soil, with *recent* dung, (see No. 459,) and the other, by placing the top earth ridgeways, as described in fig. 23, No. 453, particularly if the trenching be done in autumn, or the land be not immediately cropped.

457. *General Remarks*.—Enough has been advanced to convey a clear idea of the various modes by which the operation of trenching is performed: some *preparatory operations* will, however, in all likelihood, be required. If the ground intended to be trenched, be in a *meadow*, or covered with *grass turf*, I would recommend, instead of throwing that turf into the bottoms of the trenches, to have it pared off to the depth of three or four inches, and carried to a spare piece of ground on which it is intended to form the compost and manure heaps. There, let the turves be piled in a square heap in the following way:—Mark out an oblong space, say three yards by five: lay the sods within these limits, in regular order, to the depth of twelve inches,—then, if the surface be of fifteen square yards, sprinkle regularly over it four pounds of *common salt*: pile on more *turf* to the depth of twelve inches, upon which sprinkle the same

quantity of salt. Proceed thus with layers of turf and sprinklings of salt, in similar proportions, till the whole of the parings be heaped up, the last layer or two of which should be placed with the grass downwards; finish with a sprinkling of salt, and upon that, place a stratum of sea-coal or wood-ashes, to the depth of three or four inches. By thus employing the turf, a foundation is laid for a compost-heap of fine vegetable mould for manuring the garden. In a month or six weeks, this heap may be turned over, and blended with sand-ashes, or other light substances, if the quality of the soil be naturally strong and binding; or with stiff loam and stable dung, if the land be light and sandy.

For the purposes of floriculture, and the cultivation of greenhouse plants, a grass turf-heap should be formed, by paring the turfs one inch thick from a field or common, of unctuous, velvety lam. They should be piled up, grass surface downward, without the salt and ashes, and after fermenting in the air during one entire season, be cut to pieces, blended, and turned. Soil so prepared, is very superior.

458. *Draining* may be required, but this should be avoided if it be possible, for the process is tedious and expensive; however, if the sub-soil be springy, and hold water, and there be no choice of situation, a few open stone drains, having a slight fall in the direction of the slope of the land, must be so constructed as to carry off the water into some ditch, or other water course below the bottom level of the trenching: for if this be not done, the roots of trees will become diseased, and canker will be produced.

459. *Depth of Trenching*.—In many instances it is desirable to have a staple of well broken and pulverized ground to the depth of three or four feet; but as it is evident, that very few gardens which produce excellent crops, possess such a staple; and as it is not probable that a piece of unwrought land can be found that will admit of a regular trenching in good, or even medium soil, to the depth of three feet, I am of opinion that, in a general way, it will be prudent to limit the depth of the trenching to two feet. Let the whole of the land intended to be formed into a garden or orchard, be trenched by one or other of the foregoing methods, to the depth of two feet; then dig the bottom of each trench a full spit deep, turn and work the soil, and put on it at least three inches of stable dung, rich, for the reasons assigned at Nos. 15 and 17 of the section on *Earths and Soils*, ought, I think, to be in a recent unfermented state. The earth thrown upon this dung should be incorporated with sand or sea-coal ashes, if it be strong and binding, or with stiff loam if it be naturally light and friable. If the trenching be

performed late in autumn, it will be highly advantageous to set up the surface of the soil in ridges, that it may be fully exposed to the influences of the sun and air. During frosty weather, the spaces between the ridges should be well manured with rotten dung, or vegetable compost; which, after a thaw, when the surface has become so dry as to permit the free use of the spade, should be thoroughly incorporated with the soil. On the importance of ridging, Nicol observes, that it has “the happiest effects, especially for stiff soils, and should never be omitted when the ground is not under crop. In dead sandy loams also, and in cankering gravels, it is of incalculable advantage, and greatly meliorates them. For it is a fact, proved by experience, that exposing soil to the sun’s rays in part, by throwing it into a heap whereby it is partly shaded, and trenching it once a month, or in two months, will sooner restore it to fertility than any other process, exclusively of adding fresh matter.”

460. *Importance of Trenching to the growth of Timber.*—A treatise on gardening may not be the most suitable medium for the discussion of the subject of forest-trees; but as a plantation or screen of those trees is deemed essential to a good garden, I cannot pass over the subject in entire silence. It has of late become one of great interest, particularly in consequence of the masterly publications of Mr. Withers, of Holt, Norfolk, which have led to a controversy—if so it may be termed—on the results of trenching. Much ability has been displayed, and one of the writers opposed to Mr. Withers, has adduced arguments in proof of the importance of deep tillage, so accordant with philosophic truth, that it would be unjust to withhold them. They are extracted from page 24 of Mr. Withers’ Letter to Sir Henry Steuart, author of the *Planters’ Guide*. I greatly regret that I am obliged to abbreviate the very apt quotation which that gentleman has made from the *Planters’ Guide*; the passages selected will, however, be found to bear at once upon the question, and to appear absolutely conclusive. I therefore have arranged the several important particulars treated of, under separate heads, as comprising so many *axioms* to be observed by every planter, whose aim it is to secure a successful result.

#### SIR HENRY STEUART’S RULES FOR GENERAL PLANTING.

(1.) “*Trees, far more than agricultural crops, require depth of soil to raise them to perfection: the effect of climate appears much less necessary in giving them their greatest magnitude. If, in transplanting, we must often increase the cold, and other circumstances adverse to trees, it becomes us the more diligently to study*

that the soil be rendered *rich* and *deep as possible*, in order in some sort to counterbalance those disadvantages."

(2.) "DEEPENING can be executed with effect, only by trenching, or double-digging (for the plough can do little in such a business); and pulverizing is naturally combined with that process. The depth of pulverization, as Sir Humphry Davy well observes, must depend on the nature of the soil and subsoil. In rich clayey soils it can scarcely be too deep; and even in sands, unless the subsoil contains some principle noxious to vegetables, deep comminution should be practised. When the roots are deep, they are less liable to be injured by excessive rain, or excessive drought, and the radicles are shot forth into every part of the soil. In a word, nothing but water stagnating under the trench, in consequence of a clayey bottom, and the risk of the roots being thereby chilled, should prevent trenching from being always executed as deep as possible.

(3.) "PULVERIZATION, or the mechanical division of parts, is applicable to all soils in proportion to their adhesive texture; the more we comminute the soil, the more those fibres" (fibrous roots) "will be increased, the more this nourishment will be absorbed, and the more vigorous and healthy the plant will become.

(4.) "WATER is necessary to the growth of plants; it is essential to the juices or extract of the vegetable matter which they contain; and unless the soil, by means of comminution, be fitted to retain the quantity of water requisite to produce those juices, the addition of manure will be useless. Manure is ineffectual towards vegetation until it becomes soluble in water; and it would remain useless in a state of solution, if it so abounded as utterly to exclude air; for in that case, the fibres or mouths of plants would be unable to perform their functions, and they would soon drop off and decay."—"Water, moreover, is known to be a condenser and solvent of carbonic acid gas, which, when the ground is open, can be carried immediately to the roots of vegetables, and probably contributes to their growth."—"Let it be observed, also, that an open soil, besides being favourable to the transmission of nutriment to the roots of plants, is likewise favourable to their extension, and thereby enlarges the field whence nutriment is derived. Nor are these the only benefits resulting from a friable soil; for, in addition to its being adapted to supply vegetables with food, it is always most suitable for effecting those changes in the manure itself, which are equally necessary to the preparation of such food; and animal and vegetable substances, exposed to the alternate action of *heat, moisture, light, and air*, undergo *spontaneous decompositions*, which, independently of it, would not take place.

(5.) “Soils are surprisingly benefited by aëration, and the free admission of the weather into their interior parts. This is generally considered as the principal use of fallowing; and its importance in gardening is proved by compost-heaps, and both winter and summer ridging up.

(6.) “Soils, then, may be most effectually improved by the planter, by altering their constituent parts, as has been above shown, either by the addition of ingredients in which they are deficient, or by the subtraction of others that too much abound in them; but in ordinary cases, chiefly by the former way, by admixture with other soils, or by the application of mineral manures. The best natural soils are certainly those of which the materials have been derived from different strata, that have been minutely divided by air and water, and are intimately blended together. On this account, in improving soils by artificial methods, the husbandman, or the arboriculturist, cannot steer in so safe a course, as by studying the effects of intermixture, and imitating the chemistry of nature.”

## PART IV.

### PROTECTION AND SHELTER.

461. IN order that it may be productive of choice and early fruits of all kinds, a garden must be effectually protected from cold and biting winds. The enclosures must also be of such a nature as not only to insure the production of fruit, by the amelioration of climate, but to preserve the fruits so obtained from depredation, by presenting an insurmountable barrier against every attempt from without. As the garden which I propose to construct will comprise three departments—the *main garden*, the *slips*, and the *orchards*—I shall describe the enclosure of each under a separate head.

462. *The protection of the main garden.*—This can be effectually obtained only by means of a good wall; for although, as Nicol observes, “a kitchen garden, considered merely as such, may be as completely fenced and sheltered by hedges as by walls;” yet, in order to make every portion of the garden productive; that is, to suffer no part, not even its bulwarks and defences, to occupy ground without making an adequate return, it is indispensably necessary to surround the main garden by a wall or [paling, to which fruit trees can be trained on both its sides. If it be desirable to obtain the finer kinds of fruit, a wall is so much superior to a wooden fence, that there can be no hesitation as to which of the two modes of enclosure ought to be adopted.

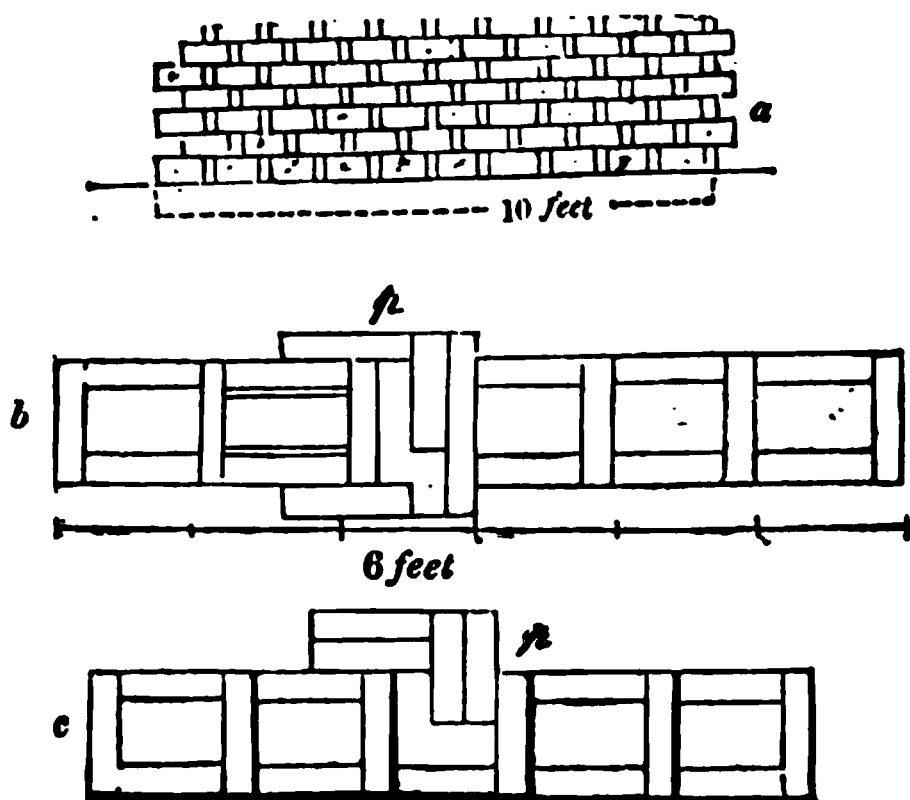
463. *Materials for kitchen-garden walls.*—"Brick is almost universally preferred; Forsyth says, 'where brick cannot be got, it is better to dispense with walls altogether, or to adopt wooden ones. 'Brick,' Nicol states, 'is best for the superstructure, and stone for the foundation and basement. Bricks give more warmth, and answer better for training trees to, than stone. South, east, and west aspects should therefore be faced with brick, if the wall be not entirely built of it.'"—(*Encyc. of Gard.*, 2460.)

"In some cases where it is intended that the roots should have free access to both sides of the wall, it should be placed on arches or piers, with plank stones, the soffit of the stone, or under crown of the arch being within six inches, or one foot of the surface, and the openings smaller or larger according to the power of the materials to resist the pressure of the wall. The arch should be a segment of a circle or of an ellipsis, and the piers proportioned to the qualities. Where the body of the wall commences," (that is, above the crown of the arches,) "there will be a set-off or rebate, of one or two inches on each side, which should be commenced below the ground's surface, both for the sake of appearance, and to prevent the alternate action of the air and rain from rotting the mortar in the rebate."—(*Idem*, No. 1557.)

464. "*The solid brick wall* is the simplest of all garden walls, and where the height does not exceed six feet, nine inches in thickness will suffice; when above that to thirteen feet, fourteen inches, and when from thirteen to twenty feet, eighteen inches in thickness are requisite. In most cases such walls may be contracted in width as they are carried up, so that a twenty-foot wall may begin with eighteen, and terminate in nine inches in breadth."

465. "*The cellular wall* is a recent invention (*Hort. Trans.*

Fig. 25.



Vol. IV.) the essential part of the construction of which is, that the wall is built hollow, or at least with communicating vacuities, equally distributed from the surface of the ground to the coping. If the height does not exceed ten or twelve feet, these walls may be formed of bricks set on edge, each course or layer consisting of an alternate series of two bricks set edgeways, and one set across, forming a thickness of nine inches: and a series of cells, nine inches in the length of the wall, by three inches broad. The second course being laid in the same way, but the bricks alternating or breaking joint with the first." The annexed figure will exhibit the appearance of the flat surface of the wall (25, *a*) and that of the internal structure, during the progress of erection, laid down on a much larger scale; *b*, shows one course of bricks; *c*, the course above it, in the alternate order in which the bricks are laid; *p*, *p*, are the piers. The figures, as well as the description, are taken from the *Encyclopædia of Gardening*, No. 1561.

466. *Remarks on the construction and surfaces of walls.*—It cannot be questioned that bricks are the best of materials with which to erect a garden wall: they not only reflect heat more regularly and durably than either wood or stone, but they form a true and level surface, and this is indispensably required for the purposes of training and nailing. Some saving in the cost of materials might be effected by erecting the wall upon rather wide arches, or by building it chiefly of rough and unhewn stones, with a facing of bricks on the sides within the main garden; but there are weighty objections against both of these methods, and these I shall proceed to state.

1st. *If the wall were erected on arches*, the roots of the trees would doubtless be at liberty to ramify and proceed in all directions, and that too, without danger of receiving injury in the way mentioned by Justice, who says that, "when the roots go out at the back sides of the wall at their freedom, they draw all the rancid juices from the earths at the backs of the walls; in consequence of which, the fruit infallibly falls off, after it has acquired its magnitude, &c." Ground that has been trenched and manured alike, both within and without the area of the chief garden, cannot injure trees by the rancidity of their juices, let the roots run therein in whatever direction they may: so far, therefore, the objection against arches is of no weight; but the objection which can neither be met nor obviated is, I think, to be found in the fact, that the roots of trees wholly dissimilar and anomalous in their nature and constitution, must come into immediate contact, and intertwine one with another. *Different trees require different aspects; the tree planted on the*

north wall, within the garden, is one which requires a southern aspect,—it may be a peach, a vine, or an apricot: immediately at the back of such a tree, with only the substance of the wall intervening, will probably be found a pear, a morello cherry, and a hardy plum. Now, who shall say what may result from the operations of vegetable chemistry, when excited by such agents as air and the sun's rays, on roots possessing very heterogeneous qualities. Some fruits are known to undergo changes: it is an acknowledged fact that several species of the apple, in particular, have degenerated; some, it should appear, are either irrecoverably lost, or are verging to extinction. To what causes can these effects be attributed? May not the disappearance, or degeneracy of a species or variety be in some degree, at least, dependent upon the chemical action excited on the juices of its roots, by the proximity of the roots of other trees possessing different qualities? Dutrochet's hypothesis of the electric attraction between fluids of different densities, will surely, I think, bear upon the question;—it embraces considerations of high importance, such as may not perhaps for a time be even “dreamt of in our philosophy.” It may be urged that the nature of the sap—that uniform watery fluid extracted from the common matrix—does not by any means authorize the supposition that any chemical action *could* be exerted between the vessels of two plants replete with so simple a fluid. But the question does not concern the sap, or the juices of the soil: it refers to the juices of the roots, those proper elaborated fluids, which have been returned by the descending vessels, and deposited in the cells of the *bark*. What alterations may not be produced by electro-chemical attraction, exerted through the vegetable membrane of the cuticle, between fluids of such anomalous characters? Experience and close observation can alone determine the inquiry; but I think it far from improbable that *indiscriminate planting* has led to, and is daily producing very unsatisfactory results; that great changes are wrought by the contact of the roots of trees possessing different qualities; and that, therefore, it will be prudent, in making plantations of any kind, to keep the trees as *select* as possible; and with respect to choice wall-trees, in particular, to prevent, as much as may be, the roots of one genus or species from coming into contact with those of other trees possessing very dissimilar properties.

467. *As to the materials of walls*, much must depend upon the object which the gardener has in view. If he desire to have good wall-fruit of every description, and to make every portion of his ground available, he must plant on both sides; and to do this, so as to enjoy the gratification of training his own trees in beautiful order,

from the graft, to a state of full maturity, the surfaces of his wall must be perfectly even : for, to attempt to train with precision, on a surface composed of rugged flints, or unhewn stones, would be only to incur vexation and disappointment.

468. *The copings* should be built with semicircular bricks, or with those that are moulded into angles, and form a sharp edge at top. Copings so constructed, shoot off the rain, and thus preserve the wall : particularly if the joints be very close, and thoroughly covered with the best Parker's cement. Nicol mentions a "temporary coping of boards, projecting, perhaps, a foot or eighteen inches." Such copings, consisting of two boards, fastened together at the edges, at an angle of ninety degrees, and secured to the walls by means of strong perpendicular iron pins, built into the wall at the top, might answer the same purposes of protection from frost, during the season of blossoming, as the boards recommended at No. 86, page 81 ; and they would protect the trees on both surfaces, at one and the same time. Holes an inch and a half in diameter, should be bored about a foot from the extreme ends of each pair of boards, and at the centre of the ridge or angle formed by their junction ; the pins being fitted to the holes, and passing through them, would secure the boards from being displaced by winds. Each screen ought to be ten or twelve feet long, and the pins should project six inches above the boards. Forsyth does not name the length of his temporary copings, though he recommends this mode of protecting fruit-trees ; he says, "I would rather advise to have a movable wooden coping, fixed on with iron hooks, fastened to pieces of wood, built into the top of the wall ; these copings would also be found very convenient to fasten the nettings, &c. to, in spring, for sheltering the fruit-trees.

469. *Enclosure of the Slip, or outer Garden.*—A complete garden should have a portion of ground on the outside of, and all around the wall of the main garden. This portion of ground, or subsidiary garden, is usually termed the *slip* ; the extent and uses of which may be collected from the following quotations :—

"The ring, or outer fence of a garden, is generally placed at some distance from the fruit, or main walls. The object is to admit the use of these on both sides, as well as to obtain a portion of ground in addition to what is enclosed. This fence may either be an evergreen hedge, paling, low wall, or sunk fence ; and with or without a wire fence to exclude hares and rabbits. It may be placed at any distance from the walls, according as accidental circumstances, or the purposes to which it is intended to devote the *intervening space*, may determine." This space is technically called

the slip; and according to M'Phael, and most authors, should not be narrower than thirty feet, nor so wide as to throw the plantation for shelter too far off to produce its effect.—(*Encyc. of Gard.*, v. 2473.)

470. *The Breadth of the Slip.*—"The garden," Forsyth states, should be surrounded with a border, or slip, from forty to sixty feet wide, or more, if the ground can be spared; and this again enclosed with an oak paling, from six to eight feet high, with a *revaux-de-frise* at top to prevent people getting over: it will also strengthen the paling. By making slips on the outside of a garden-wall, you will have plenty of ground for gooseberries, currants, rawberries, &c. You may allot that part of the slips which lies nearest to the stables, (if well sheltered and exposed to the sun,) for melon and cucumber beds; and you can plant both sides of the garden-wall, which will give a great addition to the quantity of all-fruit."—(*Treatise on Fruit Trees*, 294. *Idem*, 2474.)

471. *The mode of enclosing the slips* to which I give the preference,—because it includes the three great requisites, *protection, economy of ground, and productiveness*,—is a close paling constructed of sound and well seasoned oak-plank. The main posts which support the fence, should be formed of some sort of timber which is but little subject to decay. Were acacia timber (the *locust* of North America) to be procured in England, of a size sufficient to admit of being formed into strong posts, it would be, without question, the wood of all others to be chosen. If oak be used, it should be well charred; for the stratum of charcoal, thus produced, prevents the chemical action of moisture and air upon the wood, and is, itself, wholly insoluble in water. The paling in every part should be saturated by repeated coatings of coal-tar; it will thus be rendered very hard, and almost imperishable. To this fence can be trained gooseberry, currant, and raspberry bushes, in various aspects; and thus it will produce an abundance of choice fruit. A hedge is commonly planted round the slip, but this does not appear to be the proper place for a hedge; for, as far as garden tillage extends, nothing that takes up room, and may, in all probability, harbour slugs and other vermin, should be admitted. Now, a hedge takes up much room,—if it is formed of deciduous shrubs, it occasions litter, and it will not keep out hares and rabbits. The wooden fence, on the contrary, occupies but little space; nothing can get through it; and if the top be well garnished with tenter-hooks, it will, with the other modes of defence, soon to be noticed, present an effectual obstacle to the depredations of boys and others,—“children of a larger growth,”—who feel no sort of objection to share the produce

of the garden with the owner; and who, as he has incurred all the trouble and expense of its formation, intends to retain exclusive possession of the entire produce.

472. *Enclosure of the Orchards, &c.: Ring Fence.*—It will be seen in the first section of the ensuing month, that I propose to plant two orchards, one on the west, and the other on the east side of the garden and its slips; and also to prepare a portion of ground on the north side of the garden and orchards, in order to plant a belt or screen of forest-trees, of sufficient extent from east to west, to shelter the whole of the cultivated ground from the effects of northerly winds. The orchards will form the extreme boundary of the ground on the east and west sides, and a considerable part of it, on the south side; the hedger therefore, which will be planted for their defence, will be extended, for the sake of uniformity, in front of the paling to the south, and also around the belt of trees to the north, and thus become the ring-fence of the whole.

There are two descriptions of hedges, the *deciduous* and the *evergreen*. Deciduous hedges are usually made of the hawthorn or white-thorn, and are familiarly known by the name *Quickset* hedges; sometimes the sloe, or black-thorn, the hazel, the beech, and the hornbeam, are planted and trained as hedges. Among the evergreen tribe, the holly, the yew, and the laurel, are the most commonly chosen.

The formation of a hedge is a work of some nicety; the directions for its performance should therefore be clear and intelligible. Such directions are to be found in the *Woodlands and English Gardener*,—elsewhere I have sought for them in vain.

473. *Of the Hawthorn or Quickset-hedge: (Mespilus Oxyacantha of Smith: Crataegus Oxyacantha of Linnæus.)*—The hawthorn is a shrub, or small tree, of indigenous growth; it abounds, as its specific name imports, with sharp thorns; and, as it throws out a prodigious number of shoots, is calculated to form a close and impervious fence.

“This hedge,” Mr. Cobbett says, “ought to be planted in the following manner:—The plants being first sown in beds, and then put into a nursery, ought to be taken thence when their stems are about the thickness of the point of your fore-finger. They ought to be as equal as possible in point of size; because, if one be weaker than the rest, they subdue it. Then comes a low place in the hedge; that low place becomes a gap; and a hedge with a gap in it is, in fact, no fence at all, any more than a wall with an open door in it is a protection to a house. Having got the plants ready, or rather, *before* they be taken up out of the ground, you prepare the

place to receive them. You make a ditch, six feet wide at the top, and two and a half wide at the bottom. I suppose the ground to be trenched to the width of eighteen feet from the wall. You take all the good earth from the top of the place that is to be the ditch, and lay it upon the trenched ground to the extent of two feet wide, which will make a very good and deep bed of earth for the plants, which are to form the hedge, to grow in. Then the ditch ought to be dug out to the depth of three feet, and shovelled out very clean and smooth at bottom. This bottom earth of the ditch must be carried away, for it would not do to throw it up into the border. If it be convenient, the slope of the bank ought to be covered with turf, well beaten on, and in the autumn; because, if put on in the spring, the grass would be likely to die. If not convenient to get turf, this slope ought to be thickly sown with grass-seeds from a hay-loft; and in both cases, this slope of the bank ought to be hung very regularly with dead bushes, fastened to the bank by little pegs."

"*The time of planting* is anywhere between September and April. The plants when taken up should have all the fibres taken from their roots with a sharp knife, and their main roots shortened to the length of about six inches; then they should be planted with great care, the earth put in very finely about the roots, and every plant fastened well in the ground by the foot. The earth should then be made smooth after the treading, and the plants immediately cut down to within a foot of the ground. The distance that the plants should stand from each other ought to be about fifteen inches, and the row of plants ought to stand at about a foot from the edge of the bank. The plants should be kept perfectly clear from weeds all the summer, which is very easily effected by two or three hoeings. The next spring cut them down to within an inch of the ground. Go over them in June, when they will have made considerable shoots; and cut off all the shoots close to the stem, except the two strongest of each. Let these go on through another year, and these two shoots will then be almost five feet high. Then, in winter, take one of the shoots of each plant, and *plash* it close to the bottom; that is to say, bend it down longways the hedge, and give it a cut on the upper side, about two inches from the stem; cut off the top of it, so as to leave the remainder a foot long; bend it down to the ground, making it lie as close as possible to the stems of the neighbouring plants. When this is done, cut down the upright shoots, which you have not plashed down, to within an inch or so of that part of the stem out of which the plashed shoot issues. The next October—that is to say, at the end of the fourth summer—you

will have a complete, efficient, and beautiful fence. This fence will want topping and clipping, in order to keep it of uniform height, and smooth at the sides. You may let it go to what height you please; but, in order to have a hedge thick at the bottom, you must trim the hedge in such a way as for the outsides of the bottom of it not to be *dripped* by the upper parts of the hedge. This is a very important matter; for, if the bottom of the hedge be hollow, holes are easily made in it, and it soon becomes no fence at all.”—(*Eng. Gardener*, No. 32.)

474. The reader will bear in mind that every part of the land to be cultivated—*i. e.* the main garden and slips, the orchards, the piece intended to be planted with forest-trees as a screen, and that on which the hedge is to be raised—all are to be trenched alike, and not trenched only, but, in my opinion, they ought to be manured in the way proposed at No. 459. The depth of the soil thus prepared, when it has received the addition of the top earth thrown up in digging out the ditch, will not be less than three feet six inches. In such a soil, provided the hawthorn plants be good, and the planting carefully performed, they cannot fail to strike off with vigour, and grow with rapidity. All the fibres are directed to be pruned off the roots; and if the young plants have come from a distance, and are very dry, such pruning may be advisable; but if they have been recently removed, and are in a moist state, it can scarcely be necessary to do more than shorten the roots to the required length. Harrison, when writing on the planting of fruit-trees, says, “When a tree is supplied with a corresponding quantity of roots when compared with its top, do not cut them away, as is the practice with many persons, with a view to obtain new ones; for such will be produced in abundance from the sides of those with which the tree is at present supplied. The act of taking up and replanting the tree, essentially contributes to promote this increase. Besides, *the young fibres being in an active state soon after planting*, very much contribute to the speedy establishment of the tree, which should always be promoted as much as possible. The only exception I make to the above practice is, when the fibres are very much withered and injured from being out of the ground a long time, or are otherwise damaged—in which case, pruning away such injured and damaged parts is requisite.”—(*Treatise on Fruit Trees*, p. 23.)

Some years since, I consulted Mr. Knight on the subject of root pruning. I was favoured with the following concise reply:—“You asked me, in a former letter, whether I recommended cutting off the slender, apparently dry and lifeless fibres of transplanted trees. I never take them off, knowing that they often live after they

appear to be dead; and that, if they die, they afford excellent food to the plant,—none better, if so good.”—(January 24, 1832.)

475. *In order to plant the hedge correctly*, it will be best to strain the line very tight at twelve inches from the edge of the ditch; then cut out a small trench perpendicularly by the line, drawing the earth from it, so that the trench be at the top, of the breadth of six inches, and of an equal depth. Then put in the plants, following the same method as in setting of box-edging; that is, place them perfectly upright against the perpendicular side of the trench, and close to the line; draw a little fine earth to the roots of each, and make it firm as above directed. If it be intended to have a very thick edge, then it will be proper to “put in two rows of plants, one row eighteen inches from the other, and the plants of one row placed opposite the middle of the intervals in the other row.” But observe, that as when only one row is set, the bank is to be two feet broad, and the plants are to stand in the middle of the bank, so if the edge is to be formed of two rows, the bank ought to be three feet six inches broad at the least; for as the outer row is to be planted at the distance of twelve inches from the edge of the ditch, and the second row is to stand at eighteen inches from the outer one, there would not be space enough on the bank for the roots to spread in, were it of less breadth than three feet six inches.

476. *Future attention to the hedge, &c.*—The ditch must be carefully attended to; holes should be filled up, and the sides kept straight and firm, by replacing the earth once or twice a year. The hedge will require switching, or clipping, once in the summer, before the midsummer or July shoots start; and again in the autumn, or early in the winter. In some counties, hedges are finally trimmed late in August, or early in September, while in full leaf, but after the growth of the year has ceased. Some use shears; but that instrument bruises the shoots, though it may do the work more regularly: the edge-bill, or pruning-hook, prunes with a smooth and even cut, without injuring the young shoots.

477. *Holly-hedge.*—The common holly (*Ilex aquifolium*: of the class and order *Tetrandria Tetragynia*), is a native of Britain; it flowers in May, and produces its brilliant scarlet berries in November. The holly will grow into a fine and large tree; but it is slow in growth, and, consequently, is planted in the shrubbery as an ornamental evergreen. It forms the most perfect of hedges; in appearance it is very beautiful, and for the protection it affords, it is without rival. Young plants can be purchased at the nurseries; but they may also be successfully raised from seeds; and it would be a most beautiful sight to behold a noble evergreen hedge surrounding the

whole area of the gardens, every plant of which had been raised from seed by the owner or his children. "To have such a hedge," the *English Gardener* (No. 35) says, "gather the berries in autumn, keep them in damp sand for a year; then sow them in November, and when they come up in the spring, keep the bed carefully weeded, not only then, but all through the summer; let them stand in this bed another summer; then transplant them in rows in a nursery of rich ground: there let them stand for two or three years; then plant them for the hedge at the same distances and in the same manner as directed for the honey locusts; then, when they have stood a year thus, cut them down nearly close to the ground, which will bring three or four shoots out of each plant; and with a little lopping and side pruning, carefully performed, they will, in about five years after being planted, form a very beautiful and effectual fence."—"The hollies should be planted at the same distances, and in the same manner as directed for the hawthorns; but, like other evergreens, should never be moved, except early in September, or in April."—(*Woodlands*, 304.)

The reader is now in possession of all the materials wherewith to construct a garden, its appendages, and defences; the application of these materials, and their adaptation to the laying out of the area, and to the particular and individual parts of that area, will form a very considerable part of the first section of the ensuing month.

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## SECTION II.

### PART I.

#### NATURAL HISTORY AND CULTIVATION OF ESCULENT VEGETABLES.

Subject 1. THE LETTUCE:—*Lactuca Sactica*; *Compositæ*. Class xix.  
Order i. *Syngenesia Polyg. Æqualis*, of Linnæus.

478. *The essential generic character of the genus Lactuca is—*“*Receptacle naked. Down stalked, simple. Calyx imbricated, simple, cylindrical; scales membranous at the margin.*” The British species of *Lactuca* are biennial plants; and some contend that the garden lettuce is but a variety of one of these species—the *lactuca virosa*. The cultivated lettuce will, if sown in the spring, produce ripe seeds in August; and so far it is strictly an annual; but if it be sown in autumn, it will not produce seeds till the succeeding sum-

mer. The flower-stalk rises to the height of eighteen inches or two feet; it supports an upright, irregularly branching, *diffuse panicle*, (247, i,) with palish yellow flowers, which are succeeded by many oblong, flattish seeds, black or white, surmounted by down. "The lettuce," Loudon says, "was introduced or cultivated in 1562, but from what country is unknown."

479. *Varieties and general properties.*—The varieties are numerous, but they may be arranged in two divisions, viz., the upright, oblong, or *Cos* lettuces; and the round-headed, spreading, or *cabbage* lettuces. Those of the following selection, marked with a star, are to be preferred for delicacy of flavour; the more hardy sorts, for winter standing crops, have the letter *h* placed after the names.

*Upright or Cos Lettuces.*

- \*Green Cos (*h*),
- \*White Cos,
- Black-seeded Cos (*h*),
- Egyptian Cos (*h*),
- \*Silver Cos.

*Round-headed or Cabbage Lettuces.*

- Brown Dutch (*h*),
- Tennis-ball (*h*),
- \*Admiral, or Admirable; large.
- \*Imperial, or Union.

For compactness of growth and juiciness, none equals the close-hearted Cos lettuce of the London market gardeners: it is firm, large, and crisp, abounding with juice, and entirely free from any bitter flavour. The variety known by the name of capuchin in some of the western counties, is not the common hardy green cabbage-lettuce (called *capuchin*) of the London gardens; it is a large, broad, rather open lettuce, answering to the description of the great admirable, or imperial, and of a whitish or pale yellowish green colour. Its flavour is most delicate, and its texture soft and tender, yet crisp. The seed of this most delicious cabbage, *summer* lettuce, cannot always be ripened; hence, after bad summers, it is very dear; and cultivators should by all means endeavour to save the seed whenever it is practicable. It is, I believe, synonymous with the *royal union*, or at least a close variety of that fine lettuce, the more exquisite of any that is known round the metropolis.

This lettuce, and the green and white Cos, for summer supply, the tennis-ball, or brown Dutch, and the black, or Egyptian Cos, to stand through the winter, are all that can be required for purposes of utility.

Lettuces possess some medicinal properties; their milky juice is a slight opiate, and occasionally produces drowsiness; eaten at night, this vegetable is, with some persons, favourable to sleep; but as it also possesses laxative qualities, it is apt, if eaten freely for several successive days, to derange the bowels, and to cause considerable pain and distention.

480. *Propagation and soil.*—Lettuces are raised from seed, of which one quarter of an ounce is sufficient to sow a seed-bed of forty square feet, or of about three feet wide by thirteen or fourteen feet long. The soil should be mellow, and in good heart, and thoroughly incorporated with a quantity of well-rotted dung, or rich vegetable compost manure: it cannot well be too rich, or too much wrought; for lettuces delight in a generous soil, and when young, are very weak and tender.

481. *General method of sowing, &c.*—The beds should be in the proportion of about three feet and a-half wide by fifteen or sixteen feet long. Mark out such a bed, manure it richly, and dig it carefully, incorporating the manure with the soil, and making the earth as fine as possible. Place the line at the distance of six inches within one side of the intended bed, and draw a drill about half an inch deep; fifteen inches within this first draw a second; and at another fifteen inches from the second draw a third. Three drills, with a six-inch edging of earth on the outside of the two exterior drills, will occupy three feet six inches. Mark out the alleys, twelve inches wide at the least, one on each side of the bed. Scatter the seeds evenly, and moderately thin along the drills; sift earth, which may be taken out of the alleys, through a wire sieve, all along the drills, so as to cover the seeds to the depth of half an inch; rake the bed level, press it to a firmish surface by patting with the back of the spade, and then cut the edges of the bed and those of the alleys, slanting outwards to prevent the crumbling down of the soil. As soon as the young lettuces emerge from the ground, scatter a train of powdered quick-lime along, and at about an inch or two from the rows on each side, and at the ends, so as entirely to surround them. Slugs are rapacious destroyers of young lettuces, and will devour a bed in a night or two; and lime is not a whit less efficient in repaying the injury in kind, for it appears to annihilate and decompose every slug that touches it, until it becomes slaked; after rain, therefore, the sprinkling should be renewed. When the plants are an inch high, thin them to three inches apart, and hoe the spaces between the rows with a Dutch hoe.

482. *Management of the spring and summer crops.*—The lettuces having attained the height of four inches, are either to be thinned at once, so as to stand at twelve or fourteen inches asunder, or they may be drawn in thinning order for young salading, keeping in view, that those which are left must ultimately stand fully twelve inches apart.

483. *In transplanting, proceed thus:*—having prepared another bed of rich earth, as before directed, select the best and most regu-

larly grown of the young plants, and set them in three rows, either by means of the dibber, or the planting trowel. The rows are to be fifteen inches asunder, and the plants twelve or fifteen inches apart in the rows. Be careful to bring the earth close to the points and sides of the roots, and fix the plants firmly in the ground; a little water may, in shady weather, be given to each. The lettuces left in the seed-bed, will, if kept nicely hoed, advance rapidly. When they are three parts grown, and begin to turn in their leaves, or to *cabbage*, as it is termed, choose about a dozen plants of the most forward, and collecting the leaves in the hand, pass a string of bass round the lettuce at about two-thirds of its height, to confine the leaves together, moderately close: this will assist the hearting, but it must be practised only on a few plants at a time, for it tends to make them fly up to seed. Many of the lettuces will cabbage without tying. The plants in the seed-bed, and those that have been removed, are to be treated alike; but it will be found that the former will in general make the best and largest lettuces, while those which have been transplanted, seldom attain a very large size, but rather show a tendency to run up to flower.

The large varieties of the cabbage lettuce should stand at a foot and a half distance every way, otherwise they will crowd and almost stifle each other. In transplanting lettuces, the plants should be eased out carefully with the trowel, in order to take up as many of the fibrous roots as possible; for by so doing, they will receive less check and injury, than when they are drawn out of the ground by the hand.

484. *Periods and times of sowing*—"To obtain a constant supply of good lettuces, it is advisable to sow every month, from February to July, for the main summer and autumn crops: and to sow distinct sorts in August and September, to produce late autumn and winter plants, of which a reserve is to stand for spring and early summer heading lettuces in the following year. For the first early crops, you may begin to sow at the end of January, or beginning of February, if mild dry weather; or, more generally, later in February, or in the first week of March, on a sheltered south border. Some choice kinds may be sown in a frame, and forwarded by forcing. But for the main summer crops, sow in March and April, in any open situation. Follow with secondary sowings twice or oftener every month, from May, till about the seventh of August, to provide for a succession through the summer, till October; as the plants sown early in the year, after heading fully, soon fly up to seed-stalks. The sowing, in the midst of summer, should be on shady borders. For a crop to come in during winter, and stand over partially till

spring, make two late sowings, in the third week of August, and last fortnight of September."

485. *The winter-standing crops*, to produce early spring lettuces, must be managed somewhat differently. In August and September, prepare the beds as before directed, but strike the drills only six inches apart, and sow the seeds of the hardier sorts, marked *h*, in the list of varietics, keeping each sort in a separate bed. When the plants have attained the height of three inches, which probably will be late in October, ease out as many of them as will leave the remainder in the seed-bed six inches distant one from the other: then move the surface of the soil carefully, and make it level. Transplant into warm borders, or other sheltered situations, as many well-grown and regular plants, taken out of the seed-beds, as are likely to be required. Set them in rows, six inches apart, and the plants, five or six inches from each other. Arch over these beds with hoops, connected at the sides and tops with long rods, in order to support mats; these, in rigorous weather, will defend the lettuces from the destructive effects of frost. Remove the coverings in open weather; and, at all times, admit as much air as shall be consistent with safety. Finally, if the lettuces survive the winter, in March or April, thin them to the distances of twelve inches apart. A slight hot-bed in February, would soon produce fine lettuces, if some of those thinned out were so assisted; but in any case, autumn-sown plants which have survived the winter, will come in earlier in the spring, than those which have been sown, even under protection, in the first months of the year.

486. *To save Lettuce Seed*.—Select a few of the finest and earliest plants of the several sorts when not above half grown, and either suffer them to remain and produce their seed, or what is better, remove them with the roots, as entire as possible, to situations where they may stand, each variety, quite apart from any other. Being planted in rich light soil, and in a warm exposure, where they may receive the full maturing influence of the sun, they will run to flower, and produce ripe seeds in July, August, or September.

Subject 2. **ENDIVE**:—*Chicorem Endivia*; *Compositæ Cichoraceæ*.

Class xix. Order i. *Syngenesia Polyg. Equalis* of Linnæus.

487. *Endive* is a hardy annual, a native of China; and according to Loudon, was introduced in 1548. It rises with a large head of oblong leaves, curled, fringed, and lying close to the ground; or, in one variety, growing more erect. The flower stalk is about three

feet high, and produces small compound blue flowers, having an imbricated, permanent calyx, including many tongue-shaped florets, each with an oblong germen, and slender style, succeeded by a downy seed. The wild native *Succory* (*C. Intybus*) produces beautiful blue flowers: the roots of one of the varieties, the "*chicorée à café*," are used in France to improve the flavour of coffee.

Of the cultivated endive there are three varieties:—

*Green curled Endive*, with a full head of green fringed leaves lying close to the ground: the heart is compact, white, large, and full.

*White curled Endive*, lying close to the ground; less full in the heart.

*Batavian Endive*, with broad, plain, erect leaves: heart of the plant oblong.

"The green curled variety is the hardiest, and is the principal sort for general culture for the main crops, both in autumn and winter; and the broad-leaved, (Batavian,) resembling Cos lettuce in growth, is more esteemed for culinary uses than salads; but is excellent both ways when blanched in the heart; and is proper to cultivate chiefly for autumn use."

488. *Propagation, and times of sowing*.—Endive is raised from seed, of which, for a seed-bed, containing about forty square feet, or of about three feet wide by thirteen or fourteen feet long, half an ounce is sufficient. The sowings are to be made at three or four different periods. If a very early crop be required, a small quantity should be sown about the middle, or latter end of May, but these early plants are very liable to run up to seed before they arrive at full growth. For the main crops, sow in the first week of June, and again, at the latter end of that month;—for the late autumnal and winter endive, sow in July, between the first and tenth; again in the third week;—and, finally, for the late spring crop, in the first week of August. The manner of sowing is the same as for the lettuce. See No. 481.

489. *Transplanting*.—This work is performed from June to the end of September. Choose an open spot of rich ground, well manured, light, and on a dry sub-soil, for the early crops; for the late winter and spring endive, a warm border may be preferred. When the plants are of from four to six inches growth, draw up a number of the best; trim the long straggling shoots, and set them in shallow trenches or drills, made the full depth of a hoe, about fifteen inches asunder,—the plants being ten or twelve inches apart in the trenches. Occasional watering, if the weather be dry, will be of service. Endive plants will thrive better, and grow larger, if

thinned out to the distance of twelve inches apart in the seed-beds. Transplanting does not improve the plants; but it provides for their safety in some cases, by placing them in warm and sheltered situations; and as the seed-beds must be thinned, some of the best plants taken therefrom, should be set in places where they may be preserved dry during the winter,—as on sloping banks, or high borders, and where, at the same time, they may be screened from the effects of frost.

490. *Blanching*.—By the process of blanching or bleaching, endive is deprived of that austere and bitter taste, which would render it unfit for the table. This is effected solely by intercepting the rays of light, and thus impeding the elaboration of the sap, and the decomposition of atmospheric air within the cells of the leaves—processes which are effected by the agency of light. The insipid, ascending fluid, therefore, remains in a great degree unchanged: the leaves, being deprived of light, lose their colour, the proper juices are imperfectly prepared, and the plant is rendered comparatively inodorous and insipid. There are various methods by which endive is blanched. Abercrombie says, “Choose a dry day, observing always to make choice of such plants as are quite or nearly full grown. Let the leaves be gathered up regularly, and close in the hand; and then, with a piece of strong bass, tie them neatly together. When the endive is thus tied, you may draw some earth round some of the plants almost to the top of their leaves. This will very much promote the blanching, and will make the plants exceedingly white, and tender to eat. Some people blanch endive by laying boards or tiles flatways upon the plants: the plants will be sure to whiten tolerably well by this method, but not so regularly as those whose leaves are tied together as above directed.”—(MAWE'S *Cal.*—Oct.)

For *winter blanching*,—take a quantity of full-grown plants, in a mild dry day, in November and December, &c., with their full roots, and some earth adhering thereto; and let any dry-lying ground, or border of light earth, be trenched up in high ridges, two or three feet wide at bottom, drawing into a narrow ridge at top, to throw off the falling wet; or use any large-raised heap of light earth; and let the leaves of the endive be gathered up close, and deposited horizontally into the sides of the ridges or heap of earth, almost to their tops; and here they will blanch more safe and effectually in a short time, defending them with litter in rigorous frosts.”—(*Pocket Dictionary*—‘*Chicoreum*.’)

M'Phael says,—“In a dry day, tie up endive to blanch. Also, fern, or any long litter not too heavy, may be laid on some beds, to

keep the frost from the plants, and to blanch them. If you have a dry cellar or shed, you may lay some in, or into melon or cucumber-frames, which can be covered up in frosty weather; the glasses will keep the plants dry."

Endive will not keep long when tied up—it is liable to rot; and, therefore, a few plants only should be tied up at a time. The best and most simple way of blanching appears to be the following:—Prepare in some shed, or out-house, a heap of dryish sand, and set it up in the form of the sloping roof of a house. Take up a dozen or two of the finest endive, with some soil adhering to the roots, and place them carefully in a basket. With a round-bladed garden trowel, make a sort of hollow groove at one end of the heap of sand, of sufficient depth and breadth to contain a plant; then take one out of the basket, and with one hand collect its leaves together, while the other supports the roots; in this state, place it down in the hollow, with the top of the plant just projecting above the ridge; and cover it with sand, laying it above and around, so as to keep the plant in the same position as when it was laid down. Make another hollow within an inch of the outer leaves of the first plant, and so proceed till all the plants be laid in the sand, and covered with it; then add more, till there be six inches at least of sand over the endive. Thus the whole will be covered, excepting an inch or two of the tops of the plants; for light and air being excluded, they will soon become white. In the event of sudden severe frosts, dry litter, to the depth of a foot, should be placed over the whole heap, and a mat over that.

The plants in the seed-beds may be tied and earthed up in the same manner as those that have been transplanted: thus, "If the soil be light and dry, earth them up half way; but if moist, merely tie them. The two curled sorts, if neatly earthed up, will blanch pretty well without being tied. The Batavian, from its loftier, looser growth, in every case hearts and blanches better with a bandage. The blanching will be completed sometimes in a week, when the weather is hot and dry; at others, it may take a fortnight or three weeks; after which the endive should be taken up for use, or it will soon rot, in six days or less, especially if much rain fall. To save the trouble of tying, this esculent is also occasionally blanched by setting up tilts or boards on each side of the plants, which, resting against one another in an angular form, and confined with earth, exclude the light. Further, endive may be blanched under garden pots, or blanching pots, in the manner of sea-kale. In the heat of summer and autumn, tying is best; but in wet or cold weather, to cover the plants preserves while it blanches them."—(*Encyc. of Gardening.*)

The following method has occurred to me as feasible with the *transplanted winter endive*. Preparatory to transplanting, dig shallow trenches in a sloping part of the garden, where the plants can enjoy the full sun, and be well protected from cold northerly winds. Let the trenches be made four inches deep, twelve inches wide, and about the same distance asunder. Enrich the soil at the bottom with sandy vegetable compost, and dig it in, then set the plants fourteen inches apart in the trenches. The earth that was taken out of the trenches, by being placed on each side of them, will raise a kind of protecting rampart, that will remain till all the plants are removed. As these attain their full growth, collect their leaves, and place dry and light sand around them, and so proceed till they be completely earthed up, excepting an inch or two at the tops. Prepare a covering, either by placing hoops archways over two or more trenches,—the hoops being kept together by long rods tied to them,—or by fastening two broad boards together by the edges, so as to form an angular coping. In the event of much rain, or of severe frost, mats or tarpauling should be placed over the hoops; or if the coping of boards be preferred, the edges of the boards ought to be made to extend an inch or more beyond the sides of the trenches. The shade will not only complete the blanching of the endive, but also preserve the plants from frost and rain. The whole will become white; the dry sand answering all the purposes of banking up, and placing on ridges, while the trouble of removing the plants a second time will be entirely prevented.

491. *Saving the seed*.—Select some of the finest plants in October or November, to remain, or to be transplanted in March; or sow seed in March or April, to remain, or to be transplanted in May or June; the plants to stand two feet asunder; they will in either case soon shoot up, and produce ripe seeds in July or August. When ripe collect the seed receptacles, make them perfectly dry, rub out the seed, and it will keep good several years.

## PART II.

### OPERATIONS IN THE VEGETABLE GARDEN FOR THE MONTH OF SEPTEMBER.

492. *Sow*—Lettuce, the hardy sorts (485)—twice, *i. e.* in the first and third week.

Carrot (76), to stand the winter.

Radish (352), for autumn and winter.

Small salading, two or three times, according to the demand.

Onions—the Welsh, or white, to stand the winter; in first week.

*Transplant*—York and Battersea, spring-sown cabbages (110), to come in in November.

Lettuces (483); leeks; endive (489), into trenches or warm borders.

Broccoli (124), the last time, for latest spring supply.

Celery (359), once or twice; it will not, however, grow to the size of the plants transplanted into trenches during July and August.

*Dig up potatoes* (211), and clear the ground effectually.

*Pull up onions*, and expose them for a few days to the full sun.

*Cut off the stalks of artichokes*, and weed between the plants.

*Routine Culture*.—Gather seeds as they ripen, and dry them carefully. Take away all dead or decaying stalks and leaves. Earth up celery in the trenches, and endive, either in the seed-beds or trenches, as the plants attain a full growth. Hoe, rake, weed, and remove every species of litter; and either take it to the compost heap, or reserve it for burning, to produce vegetable ashes—a fine manure for binding, heavy soils.

### SECTION III.

#### PART I.

#### NATURAL HISTORY AND CULTIVATION OF THE RASPBERRY.

*Rubus Idæus*; *Rosaceæ*. Class xii. Order iii. *Icosandria Polygynia*, of Linnæus.

THE essential generic character of the genus *Rubus* is—“*Calyx* five-cleft. Berry superior, compound, deciduous. *Receptacle* spongy, permanent.”—(*English Flora*.)

493. *The Raspberry* is a native of Britain: according to Sir J. E. Smith, it is found “in mountainous woods and thickets. Plentiful in Wales, Scotland, and the north of England. On the woody hills between Norwich and Thorpe, truly wild. Mr. Borrer finds it abundantly in some of the forests of Sussex.” It is not unfrequently found in Wiltshire, on sandy banks, and particularly in the high heath lands abounding with peat earth, on the Longleat demesne

The cultivated raspberry, the *Rubus*, of Mount Ida, has upright prickly stalks or canes ; prickly, pinnated leaves, each with three or five leaflets, the odd terminal one being somewhat the largest. The flowers are insignificant, greenish white, in paniced clusters, and are succeeded by a compound red or buff-coloured berry of delicious flavour, which, it is said, does not undergo the acetous fermentation in the stomach ; it is therefore recommended to those who are affected with gout or rheumatism. The root of the raspberry is considered to be perennial, but in fact, the perpetuation of the shrub consists in the annual production of a succession of suckers, or young shoots, which grow during one summer, mature their wood in the following autumn, and bear fruit in the succeeding year. These protrude other suckers from their roots ; after which, they die down to the ground. Thus there exists always two kinds of shoots, one bearing the fruit, the production of the preceding summer, and the other, in a green and growing state, destined to produce the fruit of the next year. On the peculiar growth of the raspberry, the *English Gardener* observes, “ It is very curious that in the northern countries of America, Nova Scotia and new Brunswick, for instance, the raspberry plant dies completely down in the fall of the year, and new shoots come up again out of the ground in the spring, much about the manner of *fern*. These shoots bear the *first* year, though they do not make their appearance above ground until June ; and where the land is clear of high trees, and where the August sun has shrivelled up the leaves of the raspberries, these shrubs form a sheet of red for scores of miles at a stretch. They are the summer fruit of the wild pigeon, and of a great variety of other birds.”—(No. 282.)

494. *The varieties* of the raspberry mentioned in the *Encyclopedia of Gardening*, are :—

Early small white,	Large yellow Antwerp*,	Twice-bearing smooth,
Large white,	Cane, or smooth-stalked,	Woodward's raspberry.
„ red,	Twice-bearing white,	
Largest red Antwerp*,	„ red,	

“ The first in the above list is a small fruit, but esteemed for its early bearing. The second and third, the common large white and red sorts, are cultivated in fuller crops, as plentiful bearers of larger berries. The two Antwerps(\*) are still superior in yielding fine fruit, and deserve a wall or espalier. The cane raspberry is a good sort for the main crop. The twice-bearers are esteemed for their singular property of producing two crops of fruit the same year, of which, the first commonly ripens in July, and the second in September and October ; and in fine dry seasons the plants will afford

some production from the second crop in November.”—(*Encyclopædia of Gardening*, 4698-9.)

495. *Propagation*.—“The varieties can be perpetuated by young sucker-shoots rising plenteously from the root in spring and summer; when these have completed one season’s growth, they are proper to detach with roots for planting, either in the autumn of the same year or the next year, in February or March, but not later than the middle of April. These new plants will bear some fruit the first year, and furnish a succession of strong bottom-shoots for full bearing the second season. New varieties are easily raised from *seed*; and they come into bearing the second year.”—(*Idem*, 4700.)

496. *Situation and Soil*.—A rich light loam, trenched two feet deep, and well manured in the first instance, is most suitable to the raspberry. The following are Abercrombie’s directions for the culture of these shrubs:—“They may be planted in any open ground in the kitchen-garden, &c., and if for a full plantation, you should plant them in rows, ranging south and north, a yard and-a-half asunder, by two or three feet distance in the rows; having, for this purpose, a quantity of young suckers, of some good bearing plants, dug up in autumn, winter, or spring, with good roots; of which, trim off any long, straggling, and woody parts, and prune the weak tops; then plant them either singly, or two or three together, at the distance above named; or they may be disposed in patches, in borders, or shrubberies, singly, or two or three together in a sort of clump. In their culture, observe, that as the same individual shoots never bear but one year, they, decaying to the root in the winter following, young ones being produced from the bottom in summer, to succeed them, the old stems must accordingly be cut down to the ground every winter, and the young ones thinned to form three or four, to five or six of the strongest stems on each stool or root; and prune them at top, cutting off the weak and bending part; and as soon as pruned, let the ground be dug between the rows, &c., and clear out all straggling plants that are distant from the main root.”—(*Dictionary, Rubus*.)

497. *M’Phael’s Directions*.—“The soil should be a deep light loam, trenched to the depth of two feet, and sufficiently manured. In hot summers the plants do best in a spot shaded from about eleven till three o’clock in the afternoon. Raspberries may be planted in rows, leaving a space of four or five feet between the rows, and three or four feet, plant from plant. The method to prune raspberries, is, in the first place, to cut out clean all the shoots which produced the fruit last year, then to cut the weakest of the

young shoots, leaving of the best ones, from three to six or eight, according to the age and strength of the mother plants. They may be pruned any time in the winter in open weather; but the safest way is to do it early in the spring, when the most severe frosts are over, for in some seasons raspberry-shoots, after pruning, are killed by hard frosts."—(*Gardener's Remembrancer*, p. 141.)

498. *Harrison's Directions*.—"It is a good plan to train raspberries against a trellis. In planting, let them be placed singly at ten inches apart, and both sides of the trellis be planted. The raspberry requires a summer and winter regulation. The first is about midsummer, or a little later; in doing which, pull up, or cut clean away to inside the soil, all suckers, except about eighteen or twenty to every bush, and, to as many more as will be wanted at the winter pruning against the trellis. By doing this, the fruit is improved in size, and the shoots which are to bear next year get well matured. Whatever shoots are produced after this regulation, let them be destroyed by pulling up, as soon as they are a foot, or half a yard high. At winter pruning, let all the shoots which bore fruit last summer be cut away close to the ground, and to every bush leave about eight or ten of those shoots produced last summer, cutting clean away all others; after this is done, they must be tied together, so that two bushes will form an arch: after being tied, let a few inches be cut off the ends. Of those trained against a trellis, leave as many good shoots, to bear next year, as will be ten inches apart, pruning a little from the ends, and then tying them to the trellis. If the plants are not very vigorous, some well-rotted manure must be dug in round the roots, but not deeper than four inches. Raspberries will bear for eight years from the time of planting, when they must be destroyed: but two years previous to this, a new plantation of them must be made in some other place, so that when the old ones are destroyed, this will be in a good bearing condition."—(*Treatise on Fruit Trees*, 303.)

Lindley observes, that if fruit is not wanted the first year after planting, "the plants will gain strength by being cut down within six inches of the ground as soon as planted." I have proved the fact, and have thus given double strength to a plantation of white raspberries. He recommends in all subsequent prunings, with a view to procure strong and well ripened shoots, and large fruit,—to cut the former year's canes down to the ground as soon as they have produced their crop, instead of allowing them to stand till the winter or spring: "this removes an unnecessary incumbrance, and at a season when sun and air are of infinite importance to the young canes."—(*Guide to the Orchard*, p. 481-2.)

499. *General Remarks.*—Experience proves that, to have a constant supply of fine fruit year after year, the ground must be frequently changed. Thus, after the raspberries have borne fruit four or five years, one or two rows should be taken up, the strongest suckers selected, and immediately planted in fresh ground, which has been deeply digged, and well prepared with manure: the early spring is better for this work than the autumn. In two years more, the same number of plants should be removed, and the strong suckers planted in rows adjoining those last set out; and thus proceeding, before any of the old plants give out, a new plantation will supply its place. The stock of bearing plants, whether they be planted against a trellis, or as bushes, may be added to, or diminished, according to the supply required. A great error is committed in annually digging the ground between the rows, or around any single plants of the raspberry, for, thereby roots are cut, and mutilations produced. It is true, that the plant is much inclined to wander, and trespass beyond its lawful bounds; but the stray suckers may be readily pulled up; and thus prevented from interfering with other productions. To do the raspberry proper justice, the ground about it ought, occasionally, to be just run over to the depth of half an inch, with the hoe, to displace unsightly weeds; and in November, it should be covered with a coat of good dung from old hot-beds or linings: the roots would thus be at once protected, and nourished by this application of manure.

A light trellis, or rail-work, is certainly to be preferred, provided it be constructed with slender stakes and a top railing, of *pseudacacia* (locust), or elder, which woods have little or no affinity with the elements of water, and consequently do not readily undergo decomposition. On such a trellis, the plants could be secured from the force of winds, and the fruit would derive improvement in consequence of its open exposure to the sun and air.

Whenever raspberry plants are removed to another situation, the old ground ought to be well manured, deeply digged, and turned, and then it should be placed under some vegetable crop. By this mode of treatment it will be brought into a condition to support raspberries again in two or three years. This is a curious and interesting fact, one which proves that it is not solely by *exhausting the soil* that certain plants deteriorate if planted on the same ground year after year; for were this the case, manuring would renovate the ground: but it fails to do so, and thus, if peas or wheat, for example, be grown repeatedly on a piece of land, the farmer may manure to whatever extent he choose, his crops will dwindle, and become poorer and poorer. This is remarkably the case in the Isle

of Thanet, where, to use the local term, if the land be "*over-peaed*," it becomes, as it were, poisoned; and, if peas be again planted though they rise from the soil, they soon turn yellow, are "*foxed*," and produce nothing of a crop. To account for this specific poisoning of the soil, we must suppose, that *particular plants convey into the soil, through the channels of their reducent vessels, certain specific fluids, which, in process of time saturate it*, and thus render it incapable of furnishing those plants any longer with wholesome aliment in fact, the soil becomes replete with fecal or excrementitious matter, and on such, the individual plant which has yielded it cannot feed; but it is not *exhausted*; so far from that, it is to all intents and purposes manured for a crop of a different nature; and thus by the theory of interchange between the fluids of the plant and those of the soil, we are enabled, philosophically, to account for the benefit which is derived from a change of crops.

## PART II.

### OPERATIONS IN THE FRUIT DEPARTMENT.

500. *Peaches and Nectarines*.—The fruit of these trees will now ripen in succession; gather it cautiously, and do not press it in order to ascertain whether it be ripe. If any branch with fruit escape from the wall, do not attempt to nail it up; but support it by means of a thin stick, passed across the branch, inserting the ends under two of the adjoining branches.

*Vines*.—Remove a few of the leaves which shade the grapes, but do not cut off any leaf which grows at the joint of the branch which bears a bunch of grapes: that leaf is of importance to the fruit, it is one of its chief organs of nutrition and maturation.

*Apples*.—Gather them as they ripen by raising them gently, and not by a sudden or violent pull, which might injure the spur. Choose a dry day for gathering apples: wipe them carefully, and place them on shelves in a dry and *dark* room.

*Strawberries*.—Fresh plantations of strong young rooted offsets should now be made. The plants may be set in long single rows round the borders, or in beds in open ground.

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## MISCELLANEOUS.

501. *Plant*—Tulips, hyacinths, narcissuses, and other bulbs. Also, ranunculuses and anemones. Take off carnation layers, and set a few of those best-rooted, in the flower borders; but plant the greater number in small beds of well-prepared ground, and some in small pots; thus, they can be readily protected by mats, &c., in winter. Treat pinks in the same way; pot some for forcing.

*Propagate*, by slips or cuttings, the laurel and Portugal laurel; and by *layers*, the bay and laurustinus.

This is a very favourable season for planting box-edging, and evergreens of every description.

Clip hedges, trim box, mow grass lawns, roll gravel walks.

502. *Selection of Shrubs and Plants now in flower.*—*Shrubs.*—The Chinese rose, pale and dark red, *Rosa sinensis*; shrubby floriferous cinquefoil, *Potentilla floribunda*; Laurustinus, *Viburnum tinus*.

*Herbaceous, &c.*—Michaelmas daisy, various, *Aster*; *Calliopsis*, two or three species; autumnal Gentian, *Gentiana amarella*; golden-rod, *Solidago virga aurea*; sun-flower, *Helianthus annuus*; *Salvia*, many varieties, *Heliotropes*, *Verbena melindres*, and *Tweediana*.

*Bulbs.*—Meadow saffron, *Colchicum autumnale*; autumnal crocus, *Crocus autumnale*; European cyclamen, *Cyclamen europæum*; lily, five or six species, *Lilium catesbei*, *Canadense*, *superbum*, &c.

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## THE NATURALISTS' CALENDAR.

## SEPTEMBER.

THERE is now a considerable reduction in the temperature, although occasionally, the heat of the days, even at the close of the month, is very oppressive. The autumnal equinox appears to regulate the character of the ensuing winter: therefore, if between the 20th and 26th of the month, west or south-west winds prevail, and the weather be mild, a mild and open winter may be expected. If the equinoctial period be boisterous and wet, a wet and windy winter will in all probability be the result; but if it be dry and keen, with the wind at north, and north-east, the succeeding winter will, in most cases, be dry and frosty.

Dews are abundant in September; they are not decomposed and taken up into the aërial ocean, as during the summer, but frequently adhere to the pointed terminations of plants and herbage throughout the whole day, affording evidence of an important change in the electric character of the great natural agents, *air and water*.

The average height of the barometer is about 29 inches 9 cts.

Ditto thermometer, 58 degrees.

*In the first week*,—Wood owls (*Strix flammea*) hoot; young goldfinches (*Fringella carduelis*) appear in flocks; swallows (*Hirundo rustica*) sing; stone curlew (*Charadrius Œdicnemus*) is heard.

*Second week*,—Ring ousel (*Turdus torquatus*) seen; flycatcher (*Muscicapa grisola*) last seen.

*Third week*,—Linnets (*Fringilla linaria*), swallows, and martins (*Hirundo rustica et urbica*); and stares, or starlings (*Sturnus vulgaris*) congregate.

*Fourth week*,—Wood-lark (*Alauda arborea*) sings; woodcock (*Scolopax rusticola*) arrives; many swallows and martins (*Hirundo*) depart.

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## OCTOBER.

## SECTION I.

## SCIENCE OF GARDENING.

## CONSTRUCTION OF A GARDEN.

## PART II.

IN the former section on this subject (September), a view was given of the preliminary operations of preparing and fencing the ground, and it now remains to consider those subsequent operations connected with the laying out, and stocking, the several parts of which the garden is composed.

In order to avoid perplexity and confusion, I shall divide the subject into four principal heads: the first will contain inquiries respecting the dimensions or extent of the garden; the second will treat of the laying out of the area; the third will furnish directions for the main garden and slips; and the fourth will describe the method of arranging and planting the orchards and screen trees.

## I.

## EXTENT OF THE GARDEN.

It would be a comparatively useless task to wade through the contradictory opinions that have been advanced by various authors who have written on the formation of gardens; I therefore confine myself to the following quotations from the comments of authorities contained in the article *Horticulture*, Part III. of the *Encyclopædia of Gardening*.

“To assist in determining the extent of a garden, Marshall says that an acre with wall-trees, hot-beds, pots, &c., will require the employment for one man, who at some busy times will need two. The size of the garden should, however, be proportioned

to the house, and to the number of inhabitants it does or may contain. This is naturally dictated; but yet it is better to have too much ground allotted, than too little, and there is nothing monstrous in a large garden annexed to a small house. Some families use few, others, many vegetables; and it makes a great difference whether the owner is curious to have a long season of the same productions, or is content to have a supply only at the more common times. But to give some rules for the quantity of the ground to be laid out, a family of four persons (exclusive of servants), should have a rood of good working, open ground, and so on in proportion. But, if possible, let the garden be rather extensive according to the family; for then a useful sprinkling of fruit-trees can be planted in it, which may be expected to do well under the common culture of the ground about them; a good portion of it also may be allotted for that agreeable fruit the strawberry in all its varieties; and the very disagreeable circumstance of being at any time short of vegetables will be avoided. It should be considered, also, that artichokes, asparagus, and a long succession of peas and beans, require a good deal of ground. Hot-beds will also take up much room, if anything considerable be done in the way of raising cucumbers, melons, &c."

"*The size of a garden may be from one acre, to six or eight acres within the walls, according to the demand for vegetables in the family.*"—(FORSYTH.)

505. *Practical Remarks.*—Observation and experience have convinced me, that a piece of ground not exceeding one quarter of an acre, will yield an abundant supply of garden vegetables for a family of four persons; but as I assume that the families I write for, will consist, upon an average, of nine or ten members; as moreover, I intend that my garden shall produce the whole supply of winter potatoes, and be made to yield everything that can be included in the plan of general *productive economy*, I must proceed upon the principle of taking ground enough. Acting upon this principle, the annexed figure will exhibit the design of a garden, the whole area of which will contain ground under the spade, sufficient to insure abundant crops for the supply of the house and the poultry yard; and which will certainly require the attention of three members of the family during four or five hours of the day. In wet or frosty weather, garden-work cannot, it is true, be done; but tools may be sharpened, manure may be carried, and other operations performed, connected with the direct pursuits of horticulture: upon the whole, the garden and its appendages will demand the care of *one* able person during twelve hours of every day; but a division of the labour among three or four persons, will so effectually

relieve and diversify it, as to render it conducive to health, cheerfulness, and mental enjoyment.

506. *Plan of the Garden.*—This comprises four principal divisions, viz. *A*, the *main garden* for vegetables, with its *slip*, or outer garden. *B*, the east, or *orchard* of espalier or dwarf-trees. *C*, the *west orchard*. *Pl*, the *belt*, or *screen* of forest-trees.

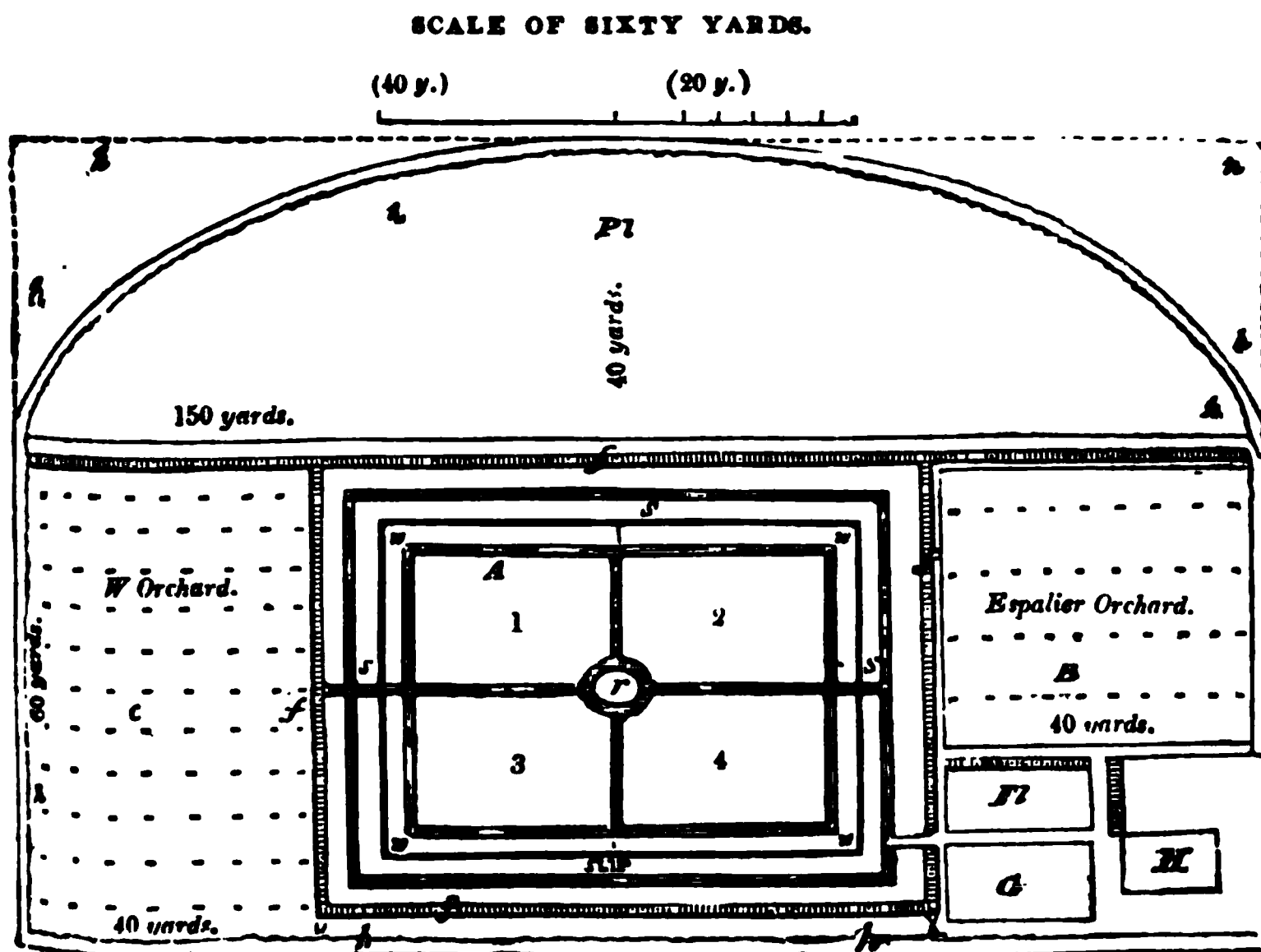


Fig. 26.

*First Division* contains within the walls *w, w, w, w*, 2,400 square yards—the length being, from east to west, 60 yards, and the breadth, from south to north, 40 yards. This garden is subdivided into a border within the walls 10 feet broad: four main quarters or plots, 1, 2, 3, 4, each being 73 feet long, and 43 feet wide; and the gravel walks. The central cross-walks, which terminate at the reservoir of water, *r*, are 6 feet wide; and the side-walks within the wall-border are 4 feet wide. The walls may be 10—or rather 12—feet high.

The *Slip*, *s, s, s*, or outer garden between the wall and the *paling*, *f, f, f, f*, consists of two borders, each 10 feet wide, with a central four-feet walk running between them. Communication with the garden, orchards, &c., is established by means of the small walks; and corresponding door-ways in the wall and fence are to be formed.

*Second Division*, *B*, is an orchard for *espalier* trees, containing 1,600 square yards. Its length and breadth are equal, each being 40 yards.

*Third Division*, *C*, another or the western orchard for *dwarf standards*: the length from north to south is 60 yards, and the breadth 40 yards; it therefore comprises 2,400 yards.

*Fourth Division*, is an oblong piece of land, *Pl*, of 160 by 40 yards; or, if pre-

ferred, it may be formed into a semi-oval: both are marked out in the plan. This piece of land extends the whole length of the cultivated area, from *E* to *W*, on the north, and is to be planted with forest-trees.

The *defences* consist of a *hedge*, *h*, *h*, *h*, *h*, &c., and a ditch on the outside of it. These surround the whole space, including the plantation, unless in one case hereafter to be noticed, when the east side of the premises, from the end of the paling, *f*, to the south-east angle of the hedge, *h*, will be defended by a brick wall 12 feet in height. The *paling* or *wooden fence*, *f*, *f*, *f*, *f*, stretches across the whole northern side of the slip and orchards, divides the slips from the orchards, and passes in front of the south side of the main garden, immediately within the hedge.

The *Space* marked *Fl. G. H.*, is a portion of the ground, 40 yards long from east to west, and 20 yards broad from north to south; and in it the house, offices, yard, and flower-garden, are supposed to be situated.

The whole area, including the plantation—if the latter be of the extent indicated by the dotted lines—will be a trifle short of three acres and one-third, exclusive of the space occupied by the ditch.

## II.

### LAYING OUT THE AREA.

507. *Order of the Work.*—There are some preliminary steps which must be taken before the ground can be stocked. In the first place, the ditch should be dugged out, and the hedge planted and defended, by setting up on the further side of the ditch, some sort of paling, as a hurdle-fence, or dead hedge. If the work be done in autumn, and if the ground be trenched, and laid up in ridges, the surface will receive the benefit of a winter fallow. The walls might be built, and the wooden paling erected in the spring following; and then, the garden should be cropped. The order of these preparatory steps might, however, be reversed, by erecting the wall in spring, after which, the trenching being performed, a summer fallow would succeed. In the autumn, the walls might be furnished, the hedge planted, and the ditch protected; and thus, the principal part of the works would be completed in one season.

508. *Preparation of the Fruit Borders.*—These borders are to be ten feet broad, for that breadth will be required in order to provide for the unimpeded ramification of the roots. But breadth is not all that will be wanted; depth and preparation of the soil must be attended to; and on these particulars Nicol has the following judicious observations:—"It is not enough that the *upper soil* of a border only be improved. The *sub-soil* must also be attended to, and be laid comfortably dry; otherwise, success in the rearing of fruits will be precarious and doubtful. Draining is the basis of every improvement in horticulture, being the basis of improvement in the soil. In

this particular case of preparing fruit-tree borders, it is indispensable. It is necessary that the roots of the trees be kept out of the sub-soil if it be of a cankering quality, as till, or corroding sand. This matter has appeared evident to many, and various means have been taken to prevent them from getting down to a bad substratum, at much trouble and expense. I shall here submit a method, the least expensive and most effectual of any, which has been successfully practised for several years.

509. *Forming an impervious Bottom to Borders.*—If the sub-soil be wet and cankering, let the border be cleared out its whole length, to the depth and breadth before mentioned. Lay the bottom in a sloping manner from the wall to the walk, giving a fall of six or eight inches. Run a drain along by the conjunction of the border and walk, a few inches lower than the bottom thus formed, which shall be capable of completely draining off both under and surface water. It may be a rubble-drain, or a box-drain, according to necessity. Now, lay over the bottom, thus formed and smooth, two inches of good earth; if clayey, so much the better, which, pulverize and pass the roller over; then an inch of pit or river gravel, which also pass the roller over; another inch of earth as above, which also roll; and, lastly, an inch of gravel, also as above. This should be done with materials rather in a dry state; but now, moisten the whole moderately with a watering pot, and roll until the surface acquires a hard shining consistency. Keep rolling and watering alternately, till the whole becomes firm and glazed, and till the earth and gravel be intimately mixed and incorporated. Thus may a bed be formed for the roots of fruit-trees, much superior to one of stone or brick, and at an expense greatly less, of a nature more kindly, and which no root will penetrate.” Nicol then directs prepared soil which had previously been laid up in a ridge along the outer edge of the border, to be thrown in:—“that for *apples, apricots, and cherries*, to be composed of three-fourths hale lightish earth, one-fourth loam, with a moderate enriching of cow-dung:—for *peaches, plums and pears*, three-fourths loam, one-fourth sandy earth, moderately enriched as above.”—(*Encyclopædia of Gardening*, Nos. 2484, *et seq.*)

510. *Remarks.*—I have thought it right to give the above quotations, but circumstances alone must determine their particular applicability. If when the foundation of the wall is laid, the bottom be found dry, and free from cankering gravel, or heavy blue clay, at the depth of thirty inches from the surface, it will scarcely be needful to construct drains, or to remove the sub-soil. In respect to *depth of soil*, the ground, it will be remembered, is to be trenched all over, two feet deep, and then to be manured. In preparing the gravel

walks, much soil will be procured: which, if it be of good quality, may be thrown on the soil of the border; and this, with the addition of the requisite top-dressings of cow-manure, will raise the border fully six inches above its previous level.

The particular modifications of soil proper for different kinds of fruit-trees will be further described in the course of the section; but to guard against all appearance of mystification—and it must be acknowledged that horticultural, as well as other professional writers, are somewhat inclined to mystify their subjects—I observe, once for all, that the dryness of the sub-soil being ascertained, the preparation of the upper soil will be a matter of comparative facility; for if the lower stratum be of a poor and unproductive quality, it will be better, after turning and manuring it as directed at No. 459, to bring in additions of fresh soil from some neighbouring meadow, and thus to procure depth of staple by adding to the top, rather than to waste time and strength in endeavouring to deepen and ameliorate that which, after all, may never make an adequate return.

After the lapse of some years, and enlarged experience and observation, I feel it a duty to qualify, to a certain extent, what has been said on *depth of soil*; for, in addition to many luminous arguments adduced by able practical writers, I have found reason to change my opinion as respects the required depth of fruit-tree borders. I have *seen* the finest fruit produced by wall-trees whose roots rested upon a bed of sheer chalk, scarcely twelve inches below the surface; and it stands to reason that, where trees are trained, in order to check the *growing principle*, and to induce *fertility*, luxuriance of growth should not be stimulated by a *deep bed* of rich and nutritive earth. I refer the reader to an able paper on this subject in the *Gardener's Magazine*, Vol. V., page 60; it speaks volumes of sound philosophical truth in a small compass. With respect to soil, I believe that the green turf of a meadow or common, the soil of which is a free, unctuous loam, cut not more than three inches thick, is the best material wherewith to prepare a fruit-border; manuring at bottom should not be practised. We do not require *luxuriance*, but a regular production of medium wood, which will ripen early; such wood alone is qualified to bear fruit in sufficient abundance. On this point also, we have the authority of Mr. Knight, and before him, that of Evelyn. Manures, they maintained, should never touch the roots, and be only applied as mulch. I possess Mr. Knight's letter on this subject.

511. *Preparation of the Walks.*—These should be of sufficient breadth, not only to allow two or three persons to walk abreast, but to permit the gardener to carry on all the necessary operations of

wheeling, barrowing, and the like, without difficulty or obstruction. Whatever be the breadth, the corners should be rounded off, for experience proves, that if the edges be planted with box, it is almost invariably trampled on and disfigured by the gardener, who, in wheeling or barrowing, endeavours, very naturally, to make the shortest turns he can.

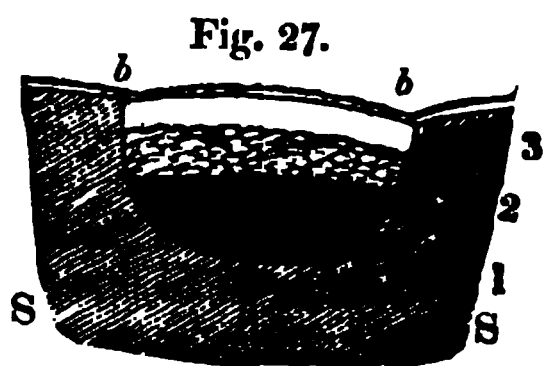
512. The *materials for walks* ought to be of a nature as binding and durable as can be procured; and for the surface stratum, gravel is at once the best, and the most ornamental. Loudon gives the following directions for the construction of gravel walks:—

“All walks consist of two parts—their substrata and surface-covering. The substratum is generally placed in an excavation, the section of which is the segment of a circle, or an inverted pointed arch, being deepest in the centre, where, in wet soils and situations, a notch or drain is often formed to carry off the water which oozes from the sides of the bottom, or sinks through the gravel. In all ordinary cases, however, the water will run off without this notch, provided the general levels of the bottoms of the walks, or the drains which cross them, or lead from them, be contrived accordingly. The foundation of the walks is to be filled with stones, the largest at the bottom; or with rubbish of old buildings, flints, or any other similar materials, observing always to place the smallest at top. When this is done, before the covering of gravel, sand, or turf, is laid on, the substratum should be well rolled, so that it may never afterwards vary its position, either with the weight of the covering, or any other weight which may pass over it. The *covering of gravel* need seldom be thicker than six inches, and generally four inches will be sufficient. That this gravel may bind in so thin a stratum, it is requisite that it be free from larger stones than those the size of a pigeon's egg, that the general size be that of large gooseberries or plums, and that there be a sixth part of rusty sand matter to promote its binding. The choice of gravel is seldom within the power of the gardener; but, in general, pit-gravel is preferred to river-gravel, as binding better, and having a better colour. The best in this respect in England, and also a good gravel for binding, is the gravel of Kensington; to which good qualities it adds, that of being the most beautiful in the world.—(*Encyc.*, 1956-7.)

513. *Particular directions.*—In constructing the walks, proceed thus:—with two lines, stretched very tight, mark out exactly the length and breadth of the walk; cut the edges true by the line, a little sloping inwards, and dig out the earth, making an excavation in the form of an inverted arch, fifteen inches deep in the centre. This done, throw the earth on the adjacent borders, and then, the bottom being made even, throw in flint, stones, lime-core, or brick-bats, to the depth of about eight inches, and roll them to a firm and level surface; upon this lay four inches of brick-bats, broken small, or to the size of pigeons' eggs, and again apply the roller. The use of this covering is partly to save gravel, the smaller particles of which would trickle through the interstices of the lowest stratum and be lost; and partly to prevent the growth of weeds, by interposing between the rough foundation and the gravel, a stratum of

some substance, whose vegetative power has been destroyed, or at least much weakened by the action of fire; upon this intermediate stratum, four or five inches of gravel are to be laid, over which the roller is to be passed, till a level and firm surface is obtained. Before applying the roller, however, upon the fine gravel, the entire surface must be trodden thoroughly, keeping the feet almost close together, and advancing inch by inch. After this operation, the surface must be smoothed with the back of a wooden-headed rake. The roller will then finish the work without leaving waviness and indentations.

In the annexed figure, *s, s*, show the soil out of which the excavation for the walk is dugged; *b, b*, mark the situation of the box-edgings, to the right and left of which are the borders—the soil to be raised an inch or two above the level of the gravel-walk.



1, is the foundation, or lowest stratum of flints, &c.; 2, is the intermediate stratum of small pieces of brick; 3, is the stratum of gravel. Some persons say it is best not to finish off a walk at once, but to do it in small portions, rolling one before another is begun: this is proved to be an error.

514. The *walk between the borders of the outer garden* need not be gravelled; it should, however, be dugged out, in order to employ the good surface-soil in deepening the fruit-border. The foundation might be made of stones, with a covering of lime-core, semi-vitrified scoræ of coal fires, or of pebbles; over which, after careful rolling, three or four inches of coal ashes would produce an excellent surface stratum. Coal ashes may be always employed to advantage in covering the alleys and small subsidiary walls. Forsyth says—"I give the preference to sea-coal ashes, which, in my opinion, make the best walks for a kitchen garden, and they are easier kept than any others, being firm and dry, and cleaner to walk upon than sand, especially after frost." To which it may be added, that they are not liable to be soiled by worms; and when they become dirtied, or cloddy with soil, they form a good manure for the beds, where the soil is clayey, and then are easily renewed.

515. *Preparation of the edgings.*—A garden never can be said to "look well," nor to be complete, without edgings of some sort. Authors are at variance on this, as on most other subjects: for while some object to box, and other verdant edgings, "as inconvenient, and harbouring slugs," others—one of whom is Abercrombie—say, that "*box is superior to everything for forming the most effectual, handsomest, and most durable edging.*"

The *English Gardener* contains, perhaps, some of the most pleasing and pertinent remarks upon the nature, merits, and construction of edgings, and from it I select those which follow. After showing the inconveniences that result from employing *thrift*, *daisies*, *strawberries*, or *grass*, it thus proceeds to evince the great superiority of *box*:—

“The box is at once the most efficient of all possible things, and the prettiest plant that can possibly be conceived. The colour and form of its leaf; its docility as to height, width, and shape; the compactness of its little branches; its great durability as a plant; its thriving in all sorts of soils, and in all sorts of aspects; its freshness under the hottest sun, and its defiance of all shade and drip;—these are beauties and qualities, which, for ages upon ages, have marked it out as the chosen plant for this very important purpose. The box, to all its other excellent qualities, adds that of facility of propagation. You take up the plants when they are from three to six inches high, when they have great numbers of shoots coming from the same stem; you strip these shoots off; put them into the ground, to about the depth of two inches, or a little more; fasten them well there, first with the hand, and then with the foot; clip them along the top to within about two inches of the ground;—and you have a box edging at once.

“To plant the box, some care must be taken. The edging ought to be planted as soon as the gravel-walks are formed. The box ought to be placed perpendicularly, and in a very straight line close to the gravel, and with no earth at all between it and the gravel. It ought to stand, when planted and cut off, about four inches high; and the earth in the borders or plats ought to be pushed back a little, and kept back for the first year, to prevent it from being washed over the walks. When the edging arrives at its proper height, it will stand about seven inches high on the gravel side, and will be about three inches higher than the earth in the border, and will act like a little wall to keep the earth out of the walks, which, to say nothing of the difference in the look, it will do as effectually as brick or boards, or anything else, however solid. The edging ought to be clipped in the winter, or very early in the spring, on both sides and at the top: a line ought to be used to regulate the movement of the shears. It ought to be clipped again, in the same manner, just about Midsummer; and if there be a more neat and beautiful thing than this in the world, all I can say is, that I never saw that thing.”—(*English Gardener*, No. 42, *et seq.*)

516. It should here be observed, that box edgings are by some directed to be planted before the walks are laid out. This might be very proper, were it intended merely to place a few inches of gravel upon the ground, and not to excavate a trench for the foundation of the walks. But if such a trench is to be digged, I put it to the judgment of every one who has seen the planting of box, whether it would be possible to do the work without disturbing and displacing the edging. I know by experience that box edgings can be planted with the utmost success after the walks have been finished, by straining the line exactly along the junction of the soil of the border with the gravel of the walk, and forming a furrow, as directed for setting quick hedges (475), in which, close by the line, the box is

to be placed, bringing the soil up to the roots: the great thing is to see that the walks be made perfectly true in the first instance; and subsequently that, the soil in which the furrow for the box is to be cut, be made quite level, by the line, and patted with the spade till it become firm; otherwise, in cutting down, a true edge can never be formed. As box affects a sandy soil, it would be advisable, either at the time of planting, or when the mould has become settled, to raise a little of the gravel with the spade or garden-trowel, and to place two or three inches of road, or light *pond sand*, about the roots; after which, the gravel is to be brought again to the side of the box, and made firm and even with the spade or roller.

517. *Water*.—On the importance of water to a garden, most authors are agreed—thus, “ Loudon and Wise, Evelyn, Hilt, and Lawrence, are warm in recommending it. M’Phael observes, that a garden, to bring the produce of the soil to the greatest perfection, ‘should be well supplied with water, to water the plants in dry seasons.’ ‘If water can be introduced,’ observes Marshall, ‘and kept clean, with verdant banks around it, it would be very useful where a garden is large, but let it be as near the centre as possible, being the most convenient situation. It should be fed from spring, and (if it could) be made to drip in the reservoir, because its trickling noise is agreeable music to most ears.’—(*Introd.*) ‘If there be no natural stream that can be conducted through the garden,’ observes Nicol, ‘water should be conveyed from the nearest river, lake, or pond; soft water being most desirable for the use of the garden.’” Justice, Forsyth, and Switzer, also agree that a garden should be well supplied with water; yet, notwithstanding all this weight of authority, it may admit of a question, whether a great deal of injury be not done by the inadequate, superficial sprinklings which are usually given to the surface. To be of service, water, when really needed, should be supplied in such abundance as to penetrate to the roots of plants; and so to supply it, watering becomes an operation of no common exertion. However, as I believe that water should be at hand, I have provided for a supply, by introducing the basin or reservoir in the centre of the garden, marked *r* in the plan. If this were supplied from a spring, by means of a jet pipe, the reservoir would become an ornamental object; but inasmuch as respects purposes of real utility, spring water is very much inferior to rain water. The latter could however be obtained, and in a state of great purity too, if a method were adopted, which, it is to be regretted, appears to be scarcely known, except in the Isle of Thanet, and, to a limited extent, in some parts of Berkshire.

518. *Reservoir of Rain Water.*—In that fertile district (*Thanet*), which, “par excellence,” is styled the “granary of London,” it is no unusual circumstance to construct underground *tanks*, so situated as to receive all the rain water that falls upon the house and adjoining offices. These tanks are generally of a cylindrical form, and resemble very broad, shallow wells; they are cased with brickwork, which is made waterproof by Roman cement. The opening at top is securely covered over with flat stones, or a brick, arched dome, excepting in one square space, that is large enough to admit flag-stone, let into a groove, but which can be taken up at any time when it is found needful to clean out the tank. Sometimes the tank is built in the shape of a large oil jar, the brickwork tapering in at a shoulder, till, at the top, it is not more than two feet across, and then a frame and trap-door complete the opening:—ricks cut across are proved to answer perfectly. In being laid with the best mortar, and permitted to settle for a fortnight, one thorough coating of Parker’s cement is amply sufficient. From 1600 to 5000 gallons of rain water may thus be collected, and preserved from dust or atmospheric influence. By means of a pump and proper conduit pipes, the reservoir in the garden could be filled with clear and pure rain water from the tank; and thus a pretty constant supply of that necessary article might be maintained.

519. *Manure and compost ground, &c.*—Upon inspection of the plan, it will be apparent that I have not set apart any particular spot in which these necessary appendages to a garden should be situated, nor one where a shed or tool-house might be erected. If it be intended to cultivate melons and cucumbers, the hot-bed ground could be enclosed with that for manure and compost heaps, and the situation for both, determined by that of the stable and farm-yard. It should, however, be altogether concealed from view of the house. The aspect ought to be good, and the exposure full to the south sun; and if that part of the ground near the house marked *F* were chosen, it would enjoy the protection of the paling or walls, which separate it on the north side from the east orchard.

*Liquid manure* is of great consequence to a garden; a drainage pit should therefore be formed in the yard, near the dung-heaps: and being made water-tight at the bottom and sides, much valuable nutritious fluid would be collected, which frequently is lost to the garden.

## III.

## PLANTING THE GARDEN.

520. *Preliminary Observations.*—On the subject of fruit-trees in general, I remark, that the catalogue of the Horticultural Society contains no fewer than twelve hundred varieties of the *apple*, and above six hundred varieties of the pear; concerning which latter fruit, it observes, that “the newly introduced *Flemish* kinds are of much more importance than the greater part of the sorts which have hitherto been cultivated in Great Britain, and when brought into use will give a new feature to the dessert.” Now, if this be the case, and if the best and most esteemed fruits may, ere long, be superseded by others, the qualities of which we are at present entirely ignorant of, what would be the use of recommending a selection of any particular known species? I shall, as usual, present a quotation or two from authorities, affording an idea of what have been deemed good and approved sorts, by very eminent gardeners; but the absolute selection must depend upon the choice of the individual. In the mean time, I observe, that, in stocking the garden with trees, I shall proceed upon principles which my own mind has suggested; they differ materially from the principles by which others—and those great men of their day—have been actuated; they may perhaps be erroneous, but still I cannot err in endeavouring to impress—earnestly to impress upon the domestic gardener—that if he be a father, the education of his sons,—or if he be not a father—his own education, in the principles of vegetable physiology, and of the philosophy of nature, should go hand in hand with the practice of domestic economy; and the planting of a garden will afford him one of the fairest opportunities of blending the two important objects. I do not deny that, in order to gain time, it may be needful, in the first instance, to purchase some large fruit-trees, to come into early bearing; and I shall adduce authorities, in order to assist the gardener in his choice of such trees; but what I wish chiefly to impress upon his understanding is this—that he should by no means be content merely to purchase trees, but resolve, without loss of time, to set about the work of propagation, either by seeds, layers, cuttings, or by any other methods that philosophy may suggest, or experience sanction. The science of gardening consists in a knowledge of first principles; and the education of the young gardener should embrace an acquaintance with causes and effects; in a word, from the seed sown in the seed-bed, to the fully developed fruit-bearing tree, the gardener should become expe-

rimentally acquainted with the entire vegetable structure,—and not with that only, but with the philosophy of all those scientific operations, by which the fertility of the tenants of the soil is either advanced or retarded. Such an education would add dignity to his labours,—such a view of causes and effects would evince that his art is an *ennobling*, and not a “grovelling” pursuit,—one in which he may find—

Tongues in the trees, books in the running brooks,  
Sermons in stones, and good in everything.

521. *Selection of wall fruit-trees.*—On this subject, Nicol says, “I have long made it my business to persuade my employers, in the planting of new gardens and orchards, to limit the varieties of fruit, in the firm conviction that I was acting for their interest; for certainly the rage for multiplying them, and of having a numerous collection, has too much prevailed of late. It were better to be contented with a few good kinds that produce well in most seasons, than to plant many sorts (even of those reckoned the finer) for the sake of variety, of which a crop is obtained perhaps once in three, or in seven years. It is no doubt of very much importance to select and adapt the kinds to the climate, soil, and aspect, and, in some cases, a greater variety may be planted with propriety than in others.”

He has added a catalogue of the several trees which he considers may form an ample collection; from it I have selected those that he marks as the best, or most valuable, rejecting apple-trees altogether; because I am satisfied that the finest apples may be produced on dwarfs and *espaliers*, and, therefore, that it would be useless to recommend the stocking of the borders with trees of a very hardy constitution, to the exclusion of others, the fruit of which cannot be brought to perfection without the shelter and protection of a wall.

522. *Selections chiefly from Nicol's list of wall fruit-trees.*

The capital letters annexed indicate the aspect suitable to each tree.

<i>Apricots.</i>		<i>Figs.</i>	
Moor Park, E. or W.		Blue or Black Ischia, S.E., S., or S.W.	
Breda, ditto.		White or brown, ditto ditto.	
Brussels, ditto.			
<i>Cherries.</i>		<i>Nectarines.</i>	
May-duke, S.E. or W.		Elruge, S.E., S., or S.W.	
Black-heart, ditto.		Fairchild's early, ditto.	
Harrison's-heart, ditto.		Murray, ditto.	
Morello, E., W., or N.			

*Peaches.*

Violet Hâtive, S.E., S., or S.W.  
 Royal George, ditto.  
 Noblesse, ditto.  
 Mellish's Favourite, ditto.

I add :—

Yellow Alberge, ditto.  
 „ Rosanna, ditto.  
 Gallande, ditto.

*Pears\*.*

Jargonelle, S.E. or W.  
 Autumn Bergamot, ditto.  
 Chaumontelle, ditto.  
 Beurré du Roi, ditto.  
 „ d'Arcenberg, ditto.  
 „ Easter, ditto.

*Plums.*

Green Gage, S.E., S., or S.W.  
 Orleans, ditto.  
 Fotheringham, E. or W.  
 White Magnum Bonum, ditto.

523. *With respect to the age of the trees*, the same writer observes, “*maiden*, or one year trained trees, are to be preferred, especially of apples and pears. Even of the stone-fruits such will succeed best, though two or three years trained are often planted. I here allude to the dwarfs. *Riders* of greater age than dwarfs may be planted in any case with propriety: they being only considered temporary, and it being desirable to obtain fruit as soon as possible.”

Harrison concurs with Nicol in preferring maiden trees; and inasmuch as concerns experience in pruning and training, the gardener should always purchase such; for then he will become intimate with his trees from the earliest shoots above the bud. But where the object is to obtain fruit as speedily as possible, the trees termed by Nicol *riders*, should be chosen. These riders are trained with a stem about six feet high; the top becomes, as it were, the centre of a circle, from which the branches radiate in a stellate order, somewhat resembling that of the spokes of a wheel. If such trees have acquired numerous and good roots, from being once or twice removed in the nursery, and be carefully transplanted, they will very speedily come into bearing, and produce good fruit during the progress of those young dwarf trees which are intended to occupy the wall. The distance at which dwarf trees are to be planted from the wall is about eight or nine inches; the temporary riders require two or three inches more.

524. *Attention to the roots in planting.*—“The roots of each plant should be trimmed previous to being planted, by pruning off

\* To the list of pear-trees ought to be added five or six varieties of the new Flemish high-flavoured pears; such as the *Napoleon*, *Marie Louise*, *Imperatrice de France*, or *Beauty of Flanders*, *Duchesse d'Angoulême*, &c., and also several of the new kinds introduced by the labours of the scientific President of the Horticultural Society, and figured in the *Hort. Trans.*

the points of those bruised in the taking up, and moderately thinning them out, if thought too thick, or too much crowded. This is seldom necessary for maiden trees, but it is often so with respect to plants that have stood several years in the nursery, or that have been trained against walls or pales, and made strong roots. The roots should in some measure be rendered proportionate to the tops; and as the shoots and branches are to be headed down, or to be well shortened and thinned out, it follows that the roots should also be moderately thinned and pruned. In doing this, however, be careful to retain those most promising, and best furnished with fibres."—(NICOL.)

This theory is more plausible than correct: roots, however numerous, cannot injure a tree. On the contrary, they add to its security at the time of planting, by enabling it to take in all the vital sap possible. The converse of the argument appears to be near the truth; for if the roots be decayed, damaged, or reduced, it will be prudent to take away a large portion of the head, leaving only a few good buds to be supplied by the small supply of sap which the mutilated roots can attract.

525. *Pruning the roots.*—It is the opinion of some, that in pruning the roots, *every fibre should be cut off*, on the supposition that these fibres never grow again—that they all die—and, therefore, may produce mouldiness and incipient disease. The subject merits inquiry. If the fibres be the organs of nutrition to the annual system of leaves only, then they doubtless perish, whether the tree be removed or not; but if they be connected, as the organs of nutrition, with those buds which lie imbedded in the bases of the leaves, and remain torpid till they become excited by the influence of spring, then it is probable that they are not all destroyed by the act of removal, and, therefore, should not be cut off, unless they have become dry and withered by long exposure to the air.

Dr. Aikin has the following judicious observations on the expansion of buds through the operation of the ascending sap:—"In trees, though the beginning and end of the first process is exactly similar to what takes place in vegetables, yet there is a second process, which, at the same time that it adds to their bulk; enables them to endure and go on increasing through a long series of years. This second process begins soon after the first, in this way:—at the base of the footstalk of each leaf is a *small bud*, gradually formed; but the absorbent vessels of the leaf having exhausted themselves in the formation of the bud, are unable to bring it nearer to maturity; in this state it exactly resembles a seed, containing within it the rudiments of vegetation, but destitute of absorbent vessels to nourish

and evolve the embryo. Being surrounded, however, by sap, like a seed in moist earth, it is in a proper situation for growing; the influence of the sun sets in motion the juices of the bud and of the seed, and the first operation in both of them is *to send down roots* a certain depth into the ground for the purpose of obtaining the necessary moisture. The bud accordingly shoots down its roots upon the *inner bark of the tree*, till they reach the part covered by the earth." —(*Nat. Hist. of the Year,—February.*)

These truly philosophical observations merit the utmost attention: they should be compared with what has been said on the *processes of vegetable nutrition*, in paragraphs 400 and 402, and the conclusion will, I think, be apparent, that the fibres which are discerned when a tree is taken up, have been protruded by the buds of the previous year, *during their expansion into the state of twigs and young branches*; and, therefore, that such fibres continue to be the vehicles of nutrition, through which the ascending sap is to be conveyed into those young branches at the ensuing spring. In pruning, then, the gardener should be guided by the state of the fibres, for if totally withered they might be removed, and, with them, a corresponding portion of the young last year's wood. But if the tree have been carefully raised without injury to the young fibres, and so speedily transplanted as to prevent their becoming withered, none need be cut off excepting such as have been bruised or lacerated. Another important conclusion to be drawn from the phenomenon of the simultaneous developement of a system of buds and fibres, is this:—that *very young trees* may be removed with a greater probability of success than others which have long established their roots in the soil, for the roots of the former can almost always be taken up entire, whereas those of the larger trees will require severe amputations, and corresponding reductions of the young branches: consequently, that the young trees will start off at once into vigorous growth, but the large trees will be rendered torpid and inactive; and thus, instead of producing growing shoots, they will be forced to develop blossom buds. It is upon the principle that *transplantation induces fertility*, that large and luxuriant trees are removed; and the practice is frequently attended with complete success.

526. *Adaptation of the wall fruit-trees.*—It will now be needful to recur to what has been said at No. 466, on the subject of promiscuous planting. My experience, it is true, does not go so far as to assure me that trees receive injury by the intertwining of the roots of different species; but there are facts which induce the belief that *surprising changes* are effected among roots by attractive agency

within the soil; and as I conceive that fruits might remain more true to their kinds, were the several trees kept select, and as much as possible apart from others of a different nature, I have arranged the distribution of the wall trees upon the principle of avoiding indiscriminate mixture, wherever it is desirable to retain an approved variety free from contamination. It is true that impregnation by the *farina* cannot thus be obviated, but such impregnation rarely affects the fruit of the present generation; the offspring—the *seed* of a fruit crossed by the *farina* of another variety—would doubtless produce a sub-variety; but a change in the actual *fruit* by such agency, must be of very rare occurrence, “otherwise,” as has been elsewhere remarked, “the produce of a common orchard would be an ever-varying round of monstrosities.”

527. *Planting the north wall of the main garden.*—This wall contains a frontage of 180 feet in length; it commands a full south exposure, and therefore, is peculiarly eligible for the peach and nectarine. Each of these trees, when fully trained, occupies at least twenty feet on a twelve-feet wall. Nine maiden trees will be planted in the border, as its permanent tenants; but eight tall riders may at first be introduced, in the intermediate spaces, to produce fruit during the training of the dwarf-trees. The peach and nectarine are so nearly related, that but little danger need be apprehended from the intermixture of their roots, nevertheless, I would prefer to keep them apart; and assuming the north and south main walk as a line of separation, I recommend that the *peaches* be planted in that part of the border which lies east of the walk, and the *nectarines* on the other part of it, to the westward.

528. The *soil* for these fine fruit-trees, Harrison says, “should be a rich loam, lighter than for apples—that taken from the surface of a field, or any other land which has not been cultivated for several years. It should not be taken deeper than twelve or fourteen inches, and ought to be procured eight or ten months before it is wanted for the border, and, during the interval, be turned over and broken.”

529. *The east and west walls*—that part of each of them situated to the north of the middle long walk, will receive six *apricot* trees, three of them enjoying an east, and three a western exposure. In choosing, give the preference to the Breda, Brussels, and Moor-park; plant them twenty feet apart, in a fresh, lightish loam. One of each sort may be placed against each of the walls, in order to vary the aspects.

530. *The half of the east wall to the south of the long walk* will admit of three May-Duke cherries, each at the distance of twenty

feet, tree from tree. The soil for cherry-trees should be a strongish loam.

531. *The half of the west wall*, directly facing the one just described, will present an east aspect to three of the choicer kinds of plum, to be planted at the same distances: Coe's golden drop for one.

"The plum-tree," Harrison observes, "prosperes best in a good strong loamy soil, for in light loam, or sandy soil, the fruit does not attain to so large a size, or so good a flavour, nor does the fruit set so freely upon the trees. Plums will do against any aspect, but it is the best method to plant early blooming kinds against south or west; and other sorts may be planted upon any aspect—thus, by having the same kinds against different aspects, some will ripen earlier than others, according to their situation, and a longer continuation of fruit will be obtained."

532. *The south wall*, 180 feet in length, with a north aspect, will receive three morella cherries at the eastern end of it, each about twenty-two feet apart; and two jargonelle pear-trees next to the cherries, but twenty-five feet from the innermost, and the same distance from each other. Finally, three of any of the hardier sorts of plum-tree, the first planted twenty-five feet from the last jargonelle, and the others twenty feet asunder, will complete the furniture of the four walls.

533. *Adaptation of trees to the outer surface of the wall*.—If the wall have been built with two smooth surfaces, those in the slip or outer garden will afford aspects equally favourable with those within the garden, but reversed in their direction. In planting the borders, those to the east and west may be furnished with the like number of trees of the same sorts as those described above at paragraphs 529 and 530, the substance of the wall alone being interposed between them. Thus, apricots will stand immediately behind apricots, plums behind plums, and cherries behind cherries.

534. In planting the *north wall*, which now has a northern aspect, as it is certain that peaches cannot be placed against a north exposure,—as some sorts of the plum will ripen well in such an exposure, and as pear-trees in general will not produce fine fruit without the influence of the sun's rays, during several hours of the day,—I advise the gardener to stock this wall with nine plum-trees of almost any kinds, not excepting the Orleans, the gages, perdigon, &c.; for although they may not produce fruit so early, or so fine, as when exposed to an east sun; yet, in all probability, the fruit will surpass that which is borne by standard-trees.

535. *The south wall* is finally to be noticed. In length, or sur-

face, it somewhat exceeds that which it presents to the north, within the area of the garden; and in regard to aspect, it is not excelled by that which is stocked with peaches and nectarines within the same enclosure. In this one instance, consistency must yield to necessity; for I must either stock this wall with the vine, and thus incur some degree of risk that the roots may intermingle with those of the cherry, pear, and plum,—or plant the tree in a situation where it will not enjoy the maturing influence of a full south sun. In the section on the vine, I shall enter into some very minute inquiries concerning the propagation of this most grateful and productive tree. At present, it will suffice to state, that fourteen trees, each trained to occupy a space of twelve feet in lateral extent, will sufficiently fill the wall—the trees being planted about thirteen feet apart, tree from tree.

In order to form some estimate of the produce of grapes from fourteen well-trained, fertile vines, we may suppose that each vine will contain twelve bearing branches, whose length will be ten feet. Now, if we allow two bunches of grapes to be produced in every foot of bearing wood, each tree will bear two hundred and forty bunches of grapes; consequently, the total produce of the fourteen vines, by this calculation, will be three thousand three hundred and sixty bunches.

The collection may consist of:—

Two black July grapes,  
Two Turner's hardy, or black  
esperance, or the esperione,  
Two white muscadine,

Two Jerusalem sweetwater,  
Two black or red Frontignac,  
Two Pitmaston, or new white cluster,  
Two Burgundy, or black cluster.

The Frontignacs are considered to be hot-house grapes, and under glass they attain, doubtless, a much higher degree of perfection; but I have known them to produce and ripen their fruit well on a south wall for many years; and the grapes are so delicious, that no good wall should be entirely destitute of them.

536. *Wall on the east side of the espalier orchard.*—In many cases, it might be both desirable and advantageous to substitute a twelve-foot wall for the hedge-fence, at the extreme boundary of the espalier orchard, particularly if a high road should happen to run along that boundary. This wall, surmounted by a *chevaux-de-frise*, or garnished with pieces of glass at the top, would afford ample protection to the orchard,—especially if, as might very well be, the ditch were continued between the road and the wall. Such a wall, being forty yards long, and four yards high, would give an additional surface of one hundred and sixty square yards, with a fine western exposure,

very suitable to the growth and ripening of the best pears. Five of the choicest Flemish, or other varieties of the pear-tree, could be planted against this wall, and trained horizontally; and as the other walls are but indifferently furnished with pear-trees, it would be advisable to devote the one in question, exclusively to the culture of these trees.

The walls are now understood to be completely stocked; and as I admit no standard or espalier trees into the main garden, for a reason hereafter to be explained, I shall complete the direction for the cropping that garden, by presenting a few calculations on the probable extent of ground which will be occupied by the chief crops of esculent vegetables.

### CROPPING THE MAIN GARDEN WITH VEGETABLES.

537. *The permanent crops of a garden*, consist of asparagus, sea-kale, artichokes, and rhubarb: these require considerable space. Three beds of asparagus, each four or five feet wide, running the whole length, from north to south, of one of the plants, would, I think, provide an ample supply. Two of these beds should be cut every spring; but one of them ought not to be cut, but be suffered to grow, in order to strengthen and re-establish the roots. This repose should be given to each of the beds in its turn: and by thus working the bed two years, and letting it rest the third, the supply would be prodigious; and in all probability, the plantations would not wear out in two generations.—(See 157.)

One or two beds of sea-kale, one bed of artichokes, and one bed of rhubarb, each of the same dimensions as those for asparagus, would, it is likely, be considered sufficient for most families.

538. *The chief temporary vegetable crops* consist of the cabbage tribe, potatoes, peas, broad and kidney beans. The cabbage tribe, which includes Savoy, broccoli, and borecole, cannot take up less than one half of the open ground of the garden nearly throughout the year. The quantity of land under the potatoe crop may be partly determined by the consumption of the article. I have found that a family of eight persons will consume a sack of potatoes, of three bushels, weighing 240 pounds, in about six weeks; nine sacks, therefore, will furnish a supply for one year, and in ordinary years,—that is, when the crop is a good average one,—nine sacks will be produced from 18 rods of land, a portion which rather exceeds one fifth of the entire area of the main garden. Potatoes, if we except the earliest varieties, are superior in quality, when they are grown in

a field; otherwise, here are two species of vegetables, which, during several months of the year, will occupy nearly three-fourths of the garden. The importance of the outer slips will now be apparent, for to them the gardener must look for his supply of the berry-bearing fruits, and of many of the less bulky vegetable crops.

539. *Rotation of crops.*—A rotation or change of crops is considered by most to be of absolute necessity—chiefly on the supposition, “that each sort of plant *draws* a somewhat different nourishment.” I am prepared to admit that each individual vegetable elaborates its own specific nutriment; that is, it induces decompositions, which afford it a supply congenial to its own peculiar habit and constitution. I also advocate the *rotation*, or change of crops—not, however, on account of the necessity of recruiting an exhausted *soil*, but for the reasons adduced at No. 499, under the article *Raspberry*, to which the reader is referred.

On this important subject—*Rotation*—something ought to be said; for, if duly attended to, the produce of the garden may be much increased. *Cabbages* prosper well after *potatoes*; and there is reason to believe, that all the plants of *Brassica* may alternate with that crop, in constantly recurring succession. Two crops of peas ought never to follow in the same, or a following season; broccoli is good rotation with them; *celery* enriches any soil, inasmuch as the trenches are highly manured; and kidney-beans will prosper in a soil so prepared. To the *phaseoli*, spinach, lettuce, radish, or any of the tap-rooted vegetables, may succeed, after a due application of manure; and *potatoes* may follow these, or any other crop.

540. *Planting the slips.*—In this department, fruit and forest-trees, and ornamental shrubs, are to be raised in seed-beds, and by cuttings and layers; nursery-beds are to be laid out for the future culture of the young plants; and grafting, inarching, budding, and all the other operations belonging to a nursery-ground, are to be carried on. The slips, in consequence of the variety of aspects which they present, are very well adapted to the cultivation of all the berry-bearing fruits, that can not only be therein produced abundantly, but in protracted succession.

A large portion of the slip, facing the east and north, should be devoted to Keen’s, Downton, Elton, Myatt’s new pine-apple, and the old pine strawberries, as their fruit prospers well, and continues long in season in cool aspects; the *Elton* is *acid*, till fully ripe; then, it becomes doubly valuable, on account of its large size and high flavoured: it also comes in late, and thus keeps up the succession.

541. *The fence, or wooden paling* surrounding the slips, presents a variety of aspects peculiarly favourable to the cultivation of cur-

rants of every kind, the Antwerp raspberry, and also of plums and morella cherries. As, however, it is by no means advisable to train trees or shrubs against a wooden fence by means of shreds and nails, a trellis of some sort or other should be constructed. The Dutch method of training to slender stakes placed perpendicularly in front of, and attached to the fence by pieces of iron hoops, might be adopted; but the neatest sort of trellis is that which is formed with stout copper bell-wire, in the manner represented in the annexed

Fig. 28.

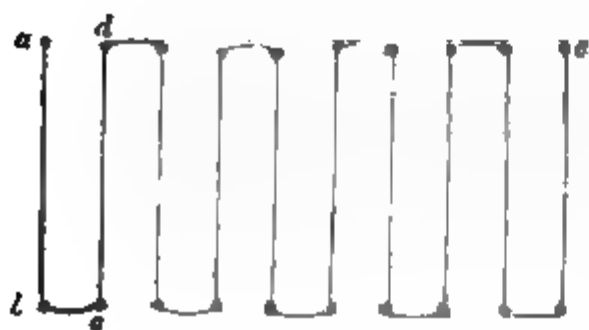


figure. Strong nails, or hooks are fastened into the upper and lower cross-rails, which connect the boards of the fence; and to one of these, as at *a*, the wire is first firmly attached; it is then carried down to the nail *b*, round which it makes a turn, and thence, sideways, to *c*; then it is taken up to *d*, and so on, in

alternate order, up and down, and across from nail to nail, till it reaches the end of the fence, where it is fastened at *e*. The nails or hooks are to be fixed 8 or 9 inches asunder, and the wires must be strained so tight, as not to yield or give way, when the young shoots or larger branches of the shrubs and trees are tied to them. Shreds of moistened bass-matting, twisted, ought to be passed, first round the shoots, and then fastened with a double knot to the wires.

542. *Espalier for grapes*.—A supply of grapes for the table has been provided, by stocking the south front of the wall with some choice vines: but I now propose to raise a plantation of these trees, with the exclusive object of producing from it a supply of cheap and salubrious wine. For this purpose, an espalier rail, about four feet and a-half, or five feet high, must be constructed of some imperishable stakes, as those of locust, elder, or laburnum. It is to extend along the entire frontage of the wall, and must stand either in the border, three feet distant from, and abreast of the wall, or close by the side of the walk. In the latter case, more of the soil of the border will be left for the cultivation of vegetable crops; but in the former, the vines will enjoy much more of the heat reflected from the wall. I therefore give it the preference. If the sacrifice of a mere strip of about four feet of the soil should be considered of importance, it could readily be provided against, by making the south slip thirty feet broad at the first laying out of the ground. The space between the espalier and the grape wall might be covered with sea-coal ashes; it would then become a convenient walk for the

gardener, be very neat in its appearance, and much facilitate the constantly-required operations of pruning and training the vines. Against this espalier rail, I propose to train a line of the *claret* grape-vine. This tree, it is supposed, will not ripen its fruit in our climate: nevertheless, on the 25th of October, 1829, after the deluges of rain which had fallen during the four preceding months, and when the temperature had generally been far below the usual average,—after so cold and ungenial a season, I saw and tasted the fruit of the *claret vine*, perfectly ripe, at Mr. Stroud's nursery, near Trowbridge; and the bulk of the crop had been sold, nearly a week before, for the express purpose of making wine. The method of planting, training, and pruning this vine on espalier, will be fully described in the section on the vine: I therefore shall only observe, that the *leaves* of the claret grape-tree, will in October produce an infusion of an exquisite purple colour, from which a wine of a very pleasant flavour can easily be prepared. If then the vine fail to mature its fruit, it will at least produce leaves; it will do more—for immature grapes, as well as leaves, will be borne; and from either or both of these, good wine may be easily and cheaply prepared. Dr. M'Culloch has written, and I have proved, that grape-leaves and sugar will produce a pure vinous liquor; and if the process be conducted in a particular manner, a *dry wine* will be the result in a very few months. It is not, however, my intention to hold out assurances, that good wine can be *speedily* perfected; but this much is certain—that wines of a quality not far inferior to some of those of France, or of the Rhine, may, in process of time, be produced; and of a nature far more salubrious than those heterogeneous mixtures, which are too frequently palmed upon the public as the genuine productions of the grape.

#### IV.

#### ARRANGEMENT OF THE ORCHARDS AND SCREEN OF FOREST-TREES.

543. *General observations on espaliers and dwarf standard trees.*—The *Encyclopædia of Gardening* observes, that “besides the value of their fruit, they form a sort of counterpart to the trees on the walls, and add much to the general effect of the garden, by increasing the appearance of design.” It will have been remarked, that trees of any kind are not introduced into the compartments of the main garden. I have not omitted them from any dislike to those beautiful

and fertile productions of nature, but because I consider that their value entitles them to occupy select and appropriate situations, where they are not so much exposed to the injury which their roots must sustain from the deep diggings and trenchings, that a vegetable garden must be subjected to, in order to insure the requisite degree of fertility. I consider the espalier tree as a valuable tenant of the soil: and in respect to culture, that it affords to the young gardener some of the most profitable lessons in *training* that he can possibly receive. Insensible, indeed, must he be to the pleasures derivable from horticultural pursuits, who can contemplate the regular progress of the lateral branches, and the gradual developement of the young fruit buds, without a feeling of delight almost amounting to ecstasy. *Dwarf standards*, as I know by experience, are often the most beautiful objects of the orchard, and they produce very excellent fruit. The fruitful Isle of Thanet furnishes unquestionable evidence of their applicability to countries which are subject to violent storms of wind; and even in comparatively tranquil districts, such is the facility with which they are kept in order, and so excellent the quality of the fruit they produce, that dwarf standard trees must ever be regarded with peculiar interest.

*Tall standards* I wholly reject, at least from the garden and orchards: they exclude much sun and air, they cast extensive shadow over the soil, and they are so unmanageable altogether, that I can only admit a few of them into the belt or screen of forest trees: in that situation, indeed, they may with great propriety be introduced.

544. *Planting the Espalier Orchard*.—In this area, containing 1600 square yards, I propose to plant nine rows of trees, twelve feet asunder, the rows running north and south. In each row there will be four trees, twenty-five feet apart. This arrangement will admit of a handsome border on the four sides of the orchard. The spaces are considerable, but they will give freedom to the growth of the trees, and to the operations of the gardener. In stocking this orchard, the rules for *select* planting ought to be rigidly adhered to, keeping apples with apples, pears with pears, cherries with cherries, and so on, that neither branches nor roots of different species, may come in contact, nor interfere one with another. Therefore, in planting, let the roots of every tree be so placed, that they may take a direction, and retain it, corresponding with that of the branches; that is, north and south. This will be readily effected, provided the trees be very young ones, and with only one single stem.

The selection may be as follows:—

(1.) *Apple-trees.*

June-eating, or genneton, the red, Keswick codling,	Ribstone pippin, Royal pearmain, Scarlet pearmain,	Hawthorndean, Old Nonpareil, Downton nonpareil;
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and twenty trees, occupying five rows, will probably be considered a fair proportion of apple-trees.

(2.) *Pear-trees.*—Two rows of pears may be sufficient. The *jargonelle*, *bergamot*, *orange bergamot*, *brown beurré*, *summer bon chretien*, &c., are, unquestionably, fine pears; but for the reason specified at No. 520, no particular varieties are now recommended.

(3.) *Cherry-trees.*—One row, containing a may-duke, an arch-duke, a *Harrison's heart*, and a *graffion*, at twenty-five feet, or five trees at twenty feet asunder, may be planted in this row.

(4.) *Plum-trees.*—One row of plums, the Orleans and green-gage, may contain four trees, at twenty-five feet, or five trees, at twenty feet, tree from tree. Thus the orchard will be stocked. With respect to the methods of constructing espalier rails, and of training the trees against them, these will be fully described in the section on the *Scientific Operations of Gardening*.

545. *Cultivation of the soil between the espaliers.*—The ground, to the extent of four feet on each side of the trees, ought never to be cropped with any kind of vegetables; it should also be kept entirely free from weeds by hoeings, or by occasional very light diggings. A sprinkling of common salt is probably the best of all manures—and as twenty bushels per acre is found to be a full allowance for any land, less than one third of that quantity would prove amply sufficient for these occasional manurings. The spaces in the middle of the ground, between every two rows of espaliers, four feet in width, must be deeply digged, and richly manured. These spaces, eight in number, would produce,—1. *Indian Corn*, the dwarf variety, known by the appellation of “Cobbett's corn.” 2. *Potatoes*, planted as directed in the article on the potatoe, by the new method. 3. *Broccoli*, four rows, the plants to stand three feet apart in the rows. 4. *Peas*, of dwarf habits. I formerly was much in favour of, and recommended the *sunflower*, but having tried it extensively, although poultry, (the feeding of which was the object,) like it extremely, yet it entices birds to the garden, in such numbers, that not only is the crop itself destroyed, but other products become the prey of their voracity.

546. *Planting the west orchard.*—The piece of land described in the plan as containing 2,400 square yards, is to be planted with seventy-seven dwarf standard trees, each sixteen feet asunder every way; or eight rows may be introduced, by planting the trees sixteen

feet apart, in the direction from north to south, and but fourteen feet in the direction from east to west.

In selecting the trees, if it be the object of the gardener to produce the finer varieties of dessert and kitchen apple, the following may be added to the selection already given at No. 544.

*Additional list of apple-trees, and the time when they generally ripen.*

Golden Harvey, November.

Common white codling, October.

Stoup codling, October.

Hallingbury pippin, very showy, September.

Newtown pippin, October.

Scarlet nonpareil, October.

547. *If the manufacture of cider were contemplated, the orchard should be stocked chiefly with some such varieties as the following:—*

The Siberian pippin, from a cross of a pearmain upon the Siberian crab, by Mr. Knight.

Yellow Siberian, produced in the same way.

Bovoy, cockagee, redstreak, and redstart.

The last is a local provincial term for a most fragrant and vinous apple, good either for the dessert or for the press; it is deeply tinged with a full marone red, and much resembles a fine large nectarine. One circumstance concerning this tree should be noted;—it strikes readily from large cuttings. I had in the year 1830, a small tree, which in 1829 produced about fifty fine apples. Its origin was a limb of at least an inch in diameter, and four feet long. This was simply thrust into the soil in the autumn of 1822; it produced three or four apples in the summer of 1823, and continued to bear fruit till I quitted my then residence.

Why the manufacture of cider should be confined to a few of the western counties is an inquiry of some interest and curiosity.

“A great deal of practical acquaintance with the qualities is required in the culture of apple and pear-trees; and his skill in the adaptation of trees to their situation principally determines the success of the manufacturer of cider and perry. The produce of the orchards is very fluctuating, and the growers seldom expect an abundant crop more than once in three years. The quantity of apples required to make a hogshead of cider is from twenty-four to thirty bushels; and in a good year an *acre of orchard* will produce somewhere about six hundred bushels, or from twenty to twenty-five hogsheads. The price of a hogshead of cider generally varies from 2*l.* to 5*l.*, according to the season and quality; but cider of the *finest* growth has sometimes been sold as high as 20*l.* by the hogshead direct from the press—a price equal to that of many of the fine wines of the Rhine or the Garonne.”  
—(*Lib. Ent. Know.*; *Apple*. 229.)

Be the effects of the soil, and the due adaptation of trees to that

\* Consult Mr. KNIGHT'S *Treatise on Cider*.

what they may, certain it is, that much of the cider is injured by carelessness and want of due attention. Rotten and decayed apples are seldom picked out; whereas, the apples should be carefully sorted over, and not one suffered to enter the press which has any appearance of decay on any part of it. One indispensable condition in the manufacture of sound, rich, and keeping cider, is, I have reason to think, the *boiling of the juice*,—without this process, the fermentation is, I think, apt to run on, till it produces a hard, unpalatable liquor, almost unfit for sale; this liquor is too often attempted to be cured, or rendered full and sweet by pernicious ingredients, among which lead, in some form or other, is found to be the most prevalent.

A correspondent of Mr. Withers, when recommending the use of *ashes* as a manure, observes, that “it cannot fail to be highly useful; it will keep the ground moist and clean, it will destroy parasitical insects which prey upon the trees, and *Darwin* would have said, ‘It stimulates them.’ In the *cider counties*, since the repeal of the *tax*, they have been again salting their cider orchards, as their fathers did before them.”—(See *Letter to Sir W. Scott*, page 62.)

If this account be correct, I heartily congratulate the farmers of these districts, and trust that these saltings, and a little industrious digging, will get rid of that monstrous and disgusting volume of moss and lichen, which has absolutely enveloped, and almost concealed, the branches of the trees, particularly in some parts of Herefordshire.

548. *Pears, morello cherries, and mulberries*, may be grown in any orchard—the first, however, but indifferently. The morello cherry bears in great perfection when in dwarf-standard; and the principal difficulty in bringing the *mulberry* to an early fruiting state soon vanishes, if the following quotation may be relied on:—“The *mulberry* is distinguished for the facility with which it may be propagated. A cutting from a tree which has borne fruit will soon become a vigorous plant. It is recorded, that at Bruce Castle, at Tottenham, an immense branch being torn off by the wind from an *mulberry-tree*, about forty years ago, the branch was thrust into the ground, and flourished. It is now a handsome tree. Recent experiments have shown that, by proper culture, both the *mulberry* and the *walnut* may be made to produce fruit at three years old.”—*ib. Ent. Knowl.*—“*Mulberry.*”)

549. *Preparation of the screen of forest-trees.*—As it is my desire to render this plantation a source of profitable return to the gardener, I lay it down as a maxim—an indispensable condition—that the land to be planted with forest-trees be prepared by deep trenching

with the spade, and by manuring during that operation, either with compost, or some raw material, suitable to the nature of the soil.

550. *Object of the work.*—The ostensible and ultimate object of the work is the raising of an efficient screen of tall forest-trees for the shelter and protection of the fruitful area from the pernicious effects of north and north-easterly winds; but there is an intermediate object which must not be lost sight of, and that is, the production of an ample supply of young wood for the use of the estate. Flower sticks, stakes, and poles, of various sizes, for espalier rails, palisades, trellises, and fences, will be required in abundance; and these must either be grown, or purchased at a considerable expense.

The *formation* of the screen itself will also be a source of much information to the gardener; for he thereby will not fail to acquire great practical knowledge of the propagation and future culture of the trees, from their first developement in the seed-bed, to their full-grown, perfect state.

By reference to the plan, the *situation* of the plantation will be found to be that portion of ground which extends in a direction from east to west, along the whole northern boundary of the garden and orchards.

551. *Order of the work.*—This will be exemplified in another plan and figure at No. 559; but it may be premised, that, as the vegetable and fruit departments will for a time require almost exclusive attention, the planting of the entire screen need not be undertaken in the first instance. It will suffice, as a preliminary step, soon after planting the hedge fence, to trench a strip of ground immediately within that fence, eighteen feet broad, for the reception of three rows of evergreens. If the evergreen oak (*Quercus Ilex*), were of more rapid growth than it is, there is no tree which could compete with it for beauty of form and foliage. The wood, too, of this tree is exceedingly durable; but as rapidity of growth is here of some consequence. I must be compelled to admit the spruce fir into the extreme boundary of the screen.

“The *Norway fir*, or common spruce fir, (*Pinus Abies*,)” Loudon observes, “is the first species of that section of pines in which the leaves are solitary. It is one of the tallest of European trees, attains from 100 to 150 feet in height, with a straight, but not thick trunk, and throwing out its spreading frond-like branches, so as to form an elegant narrow cone of vivid green.”

552. *Method of planting.*—The strip of land, eighteen feet wide, being trenched, the holes for the reception of the fir-trees must be prepared with the utmost attention to order and regularity. The line is to be strained very tight, six feet within, and distant from,

the centre of the hedge; and as it would be inconvenient to dig under and about the line, a groove should be chopped with the spade along its whole length, of such a depth as not to be obliterated during the process of digging. The distances between the holes, that is from tree to tree, can be regulated by the rule, or by a stick cut exactly to the required length. In selecting the trees, choose such plants as are perfectly healthy; their height should not exceed a foot, nor their age four years. Most authors are of opinion that very young trees—the fir tribe particularly—succeed better, and thrive more rapidly than others of greater age and larger size. Thus, the “*Woodlands*” says—“in the case of *firs* of any description, (and the same may be said of the *cedar* and *cypress*,) there is no need of any nursery at all; and the best way is to let them stand, not too thickly, two years in the seed-bed, and then put them at once into plantations. They will not be above seven or eight inches high; but they will be ten feet high before plants put out at four feet high will have attained the height of seven or eight feet. This Miller saw proved in numerous instances, and I am sure of the fact from repeated experience, and from the observation of my whole life.”—(Art. *Fir*, No. 254.)

The *Encyclopædia of Gardening*, on the fir tribe, says, that this “tribe benefits less by transplanting than the non-resinous trees, and, therefore, where circumstances admit, the better plan is, after the seedlings have stood two years in the seed bed, to remove them where they are finally to remain.”—(No. 6997.)

When the holes are ready, let as many trees as can be planted during the same day be carefully lifted, so as to preserve all their fibres entire. The roots of evergreens—of firs particularly—should not be pruned at all, unless to remove bruised or injured parts; for as the leaves are peculiarly formed, the system of fibres with which they are connected, must correspond with that peculiarity of structure, and therefore are to be considered as living organs or channels of nutrition to those leaves, and, as such, necessary to their preservation. These small fir-trees, then, with their entire roots, are to be carefully planted in the holes which are to be so prepared, that the plants may stand exactly *four feet* asunder. In placing the trees, covering the roots, and filling up the holes, observe the same precautions that were recommended in planting the wall fruit-trees in the garden borders.

One row of the trees being completed, two other rows are to be planted exactly in the same manner, and at the same distances: the trees, however, are to be placed opposite to the middle of the intervals between those of the previous row. Thus proceeding, the three

rows of firs standing each four feet asunder, including the space of six feet between the hedge and the outermost row, will occupy a belt of the land fourteen feet in breadth. The number of the fir-trees will scarcely exceed five hundred, and these are all the trees that it will be really needful to purchase; all others may be raised; for while the firs are advancing in growth, seed and nursery-beds may be formed in the outer garden for the propagation of the outer trees, from which, in the course of three or four years, they will be ready to go into plantation; and thus the important and pleasing duty of forming the screen will be performed, almost exclusively, by the gardener himself.

553. *Preliminary calculation.*—The oblong plot of land appropriated to the plantation, contained originally 6400 square yards; it will, as we have seen above, be reduced fourteen feet on each side by the rows of fir-trees; and if, in addition, we allow four feet more, as an interval between the innermost row and the row of trees next to be planted, the plot will be so far reduced as to contain only 5,032 square yards; for its length from west to east will be 148 yards, and its breadth from north to south thirty-four yards.

554. *In estimating the number of trees* which may be planted in any given extent of ground, the following simple rule will be found extremely useful. First, ascertain the extent of the area in square yards, by multiplying the length into the breadth; reduce these yards to square feet, by multiplying by 9, that being the number of square feet contained in a square yard. Thus, for instance, an acre contains 4,840 yards, and that sum multiplied by 9 will yield 43,560, being the total product or amount of square feet in a statute acre. In the next place, determine the distance in feet at which the trees are to stand, and square that number—that is to say, multiply it into itself; divide the total product by that square number, and the quotient will indicate the number of trees which the piece of land will contain.

Thus, at one foot apart, an acre of land will contain . . . .	43,560
at two feet—the square of 2 being 4= $43,560 \div 4 =$ . .	10,890
at three feet, the number will correspond with that of the	
square yards . . . . .	4,840
at four feet—the square of 4 being 16= $43,560 \div 16 =$ .	2,722
at six feet—the square of 6 being 36= $43,560 \div 36 =$ . .	1,210

555. *Selection of trees for planting the remaining space of 5,032 yards.*—It would, in my opinion, be more consistent with the philosophy of nature to plant the ground with only one kind of tree. As, however, I have to combine beauty of appearance with usefulness of design, I shall select two or three species, and plant each

in a separate belt. These trees are the ash (*Fraxinus excelsior*), the growth of which is very rapid, the stem straight, and the foliage graceful.—The locust (*Robinia pseudo-acacia*), which stands unrivalled for the durability of its timber, the exquisite gracefulness of its light-green, pinnated leaves, and the elegance of its fragrant milk-coloured flowers. Of this fine tree, the *Encyclopædia of Gardening* says, “The timber is much valued in North America, and said to be superior to that of the laburnum, being close-grained, hard, and finely veined; and in America, more valued by the cabinet-maker than any other native timber whatever. Pursh, in his valuable *Flora*, asserts, that being nearly incorruptible it is equally useful for posts and gates. We are informed by a friend, that gate-posts of this timber, on a property at Baltimore, have remained for nearly a century. The finely pinnated leaves, and pendulous white odorous flowers, add greatly to its beauty. Its value is scarcely known in this country.” (From *Caled. Mem.* ii. 414\*.)—The laburnum (*Cytisus laburnum*), of which the *Library of Entertaining Knowledge* observes, that “In England the laburnum is principally cultivated as an ornamental shrub, and when in bloom, its numerous and long branches of yellow flowers have a very showy appearance. Laburnum is, however, exceedingly useful as a tree; and wherever very hard and compact timber is required in small pieces, there are few superior to it. The Romans reckoned it next to ebony; though it be not so hard, or so perfectly free from grain, it is much more tough and elastic.” (Vol. II. part i. p. 132.)—The live oak (*Quercus phellos virens*), a tree which grows to the height of 30 or 40 feet, is beautiful in its appearance, and produces a timber of exceeding durability; however, as it may be very difficult to procure the seeds of this tree, the common evergreen, or Holme-oak (*Quercus ilex*), may be substituted for it. This tree will, as I have experienced, attain the height of 12 or 14 feet in six or seven years; and it seems to be one of the hardiest evergreens in nature,—for I never saw a leaf of it injured by any severity of weather that has occurred within the last ten years.

\* The above quotation from the *Caledonian Memoirs*, accords exactly with the facts which Mr. Cobbett has been labouring to impress for many years past. The reader who is desirous to obtain ample information concerning the culture and general properties of the *acacia* or American *locust-tree*, is referred to the *Woodlands* of that writer—a work which ought to be attentively perused by every one who intends to plant forest-trees, be his *political* sentiments what they may. Mr. WITHERS's *Memoir*, page 23, contains some interesting circumstances concerning the rapid growth of the locust. Miller and Dr. Hunter also mention the great durability of the timber.

A few standard fruit-trees can with propriety be introduced at the southern limits of the screen; and these, with some berry-bearing shrubs, will complete the plantation.

556. *General maxims and directions for planting forest-trees.*—Mr. Withers has given the following directions:—

(1.) Trench 14 or 18 inches deep, with the spade or plough, and put on as much manure as if turnips were intended to be sown.

(2.) Select your trees according to soil and situation, giving the preference to locust, ash, elm, spanish-chesnut, and oak. Plant *each sort by itself* six feet apart, and where these will grow well, reject the fir-tribe altogether.

(3.) Suffer no potatoes, carrots, or other crop to be grown among your trees; but hoe annually four or five times for three years, and after that period, twice a year for four years, whether weeds appear or not, the object being to keep the soil *loose*, as well as clean upon the surface.

(4.) If you *prune*, proceed cautiously, and merely remove competing branches, and shorten those that whip or lash surrounding trees.

(5.) *Thin* early and carefully, doing little and often, and sparing at *first* those parts exposed to the north and east winds.—(*Letter to Sir W. Scott*, 125.)

The reader should bear in mind that the foregoing are the directions of an experienced planter: his plantations speak for themselves, and all he writes is the result of practical tuition.

Nicol is of opinion, “that generally trees, three, or at most four years old from the seed, and which are from twelve to twenty-four inches high, will, in any situation or soil, outgrow those of any size under eight or ten feet, within the seventh year.”—(*Pract. Planter.*)

Pontey, planter to the Duke of Bedford, says, “None but good-rooted plants will succeed in a bad soil; while on a good one, sheltered, none but very bad-rooted plants will fail. A large plant has never so good a root in proportion to its size as a small one; and hence we see the propriety of using such on good soils only. Small plants lose but few of their roots in removal. It should never be forgotten that, in being removed, a plant of two feet loses a greater proportion of its roots than a tree of one; and a tree of three feet, a greater proportion than one of two; and so on, in proportion to its former strength and height: and thus, the larger the plants, so much greater is the degree of languor and weakness

into which they are thrown by the operation of transplanting.”—*Profit. Planter.*

557. *Heading down.*—This should never be practised on evergreens; but deciduous tress are benefited as far as figure is concerned, by a judicious performance of the work.

Forsyth “transplanted a bed of oak-plants, cutting the tap-roots near to some of the side-roots or fibres springing from them. In the second year after, he headed one-half of the plants down, and left the other half to nature. In the first season, those headed down made shoots six feet long and upwards, and completely covered the head of the old stem, leaving only a faint cicatrix, and produced new tap-roots upwards of two feet and a-half long. The other half of the plants that were not headed, were not one-fourth the size of the others.”—(*Treatise on Fruit-Trees*, 4to. edition, p. 144.)

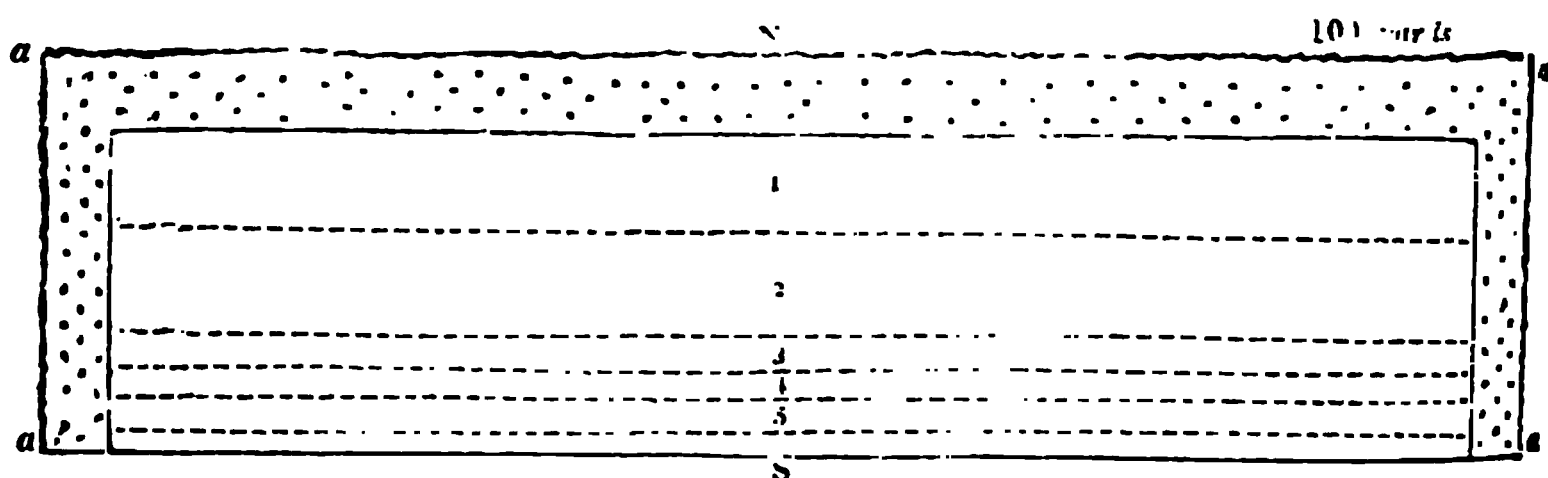
Sang, who completed WALTER NICOL’s *Planter’s Calendar*, in 1812, directs that, “after the trees have been three or four years planted, such as have not begun to grow freely should be headed down to within three or four inches of the ground. The cut must be made with a pruning-knife, in a sloping direction, with one effort. Great care should be taken not to bend over the tree in the act of cutting. By so bending, the root may be split—a thing which too often happens. The operation should be performed in March, and not at an earlier period of the season, because the wounded part might receive much injury from the severe weather in January and February, and the expected shoot be thereby prevented from rising so strong and vigorous. Buffon, in a memorial on the culture of woods, presented to the French government in 1742, says he has repeated this experiment so often, that he considers it as the most useful practice he knows in the culture of woods.”—(*Encyc. of Gard.*, 6894.)

558. *Pruning the trees.*—The object of pruning is to obtain a clean and straight stem; therefore in cutting a shoot or small branch, the wood of the stump should all be removed, for it never survives the operation. And to do this effectually, I think the wood should be scooped or hollowed out, to the depth of the inner surface of the bark; and the experimental gardener would do well to use a small sharp gouge, by which he could readily remove the projecting wood; and this would be better than to leave it in the tree, where it must ultimately form a knob. It is the *bark* which heals, or rather covers the wound: this fact, therefore, indicates the necessity of *cutting out*, and also the time of performing the operation, which should be just before the first rising of the sap. With respect to the method of performing the work, it should be determined by the consideration

that *every twig is of real utility to the plant*. Hence, in pruning to obtain a clean stem, as few shoots should be removed as possible. If the operation be commenced in the third year after heading down, cut off with a very sharp pruning-knife those shoots, and those only, which were the growth of the first year, leaving entire all the shoots of the two succeeding years. The rule will likewise hold good, if the pruning be not commenced till the fourth year. Proceed thus annually, removing the lowest tier of shoots, till the stem attain the desired length.

559. *Final arrangement of the trees*.—By referring to the annexed fig. 29, the reader will be enabled to trace the order in which I propose to complete the screen plantation. *a, a, a, a*, show the hedge fence, within which the three rows of *fir-trees* are arranged in what is termed the diamond, or *quincunx* order. The dots represent the trees, but not the exact distances; for had that been attempted, they would have been so crowded as to be almost indistinct.

Fig. 29.



No. 1 is a belt ten yards wide; it is designed to be planted with ten rows of *ash-trees*—the first row to stand *on the line* immediately within the innermost row of firs, the trees one yard apart in the rows; as, therefore, the belt contains 1480 square yards, it will receive just so many ash-trees.

No. 2 is another belt, twelve yards wide—this is to be planted with eighteen rows of pseudo-acacias, or locusts. The rows will be two feet apart, the plants two feet asunder, and the piece of land containing 15,984 square feet—this sum divided by 4, will give 3,996 locust-trees.

No. 3 and 4, each three yards broad. They are to be planted—the one next the locusts, with three rows of laburnums, the plants a yard apart; the other immediately below that, with three rows of the '*live*,' or evergreen oak, at the same distances as the laburnums—each space containing 444 yards, will also receive 444 trees.

The screen, with respect to forest-trees, will thus be complete;

and it will be found to contain nearly, if not exactly, 6,875 trees, including the firs. The acacias are planted in the close order recommended, because stakes of that very durable wood will soon be required. These trees grow rapidly, and many hundreds will be ready for cutting in two years after heading down. If the screen be so arranged, and particularly if it command the advantage of a natural slope from north to south, the effect produced by the contrast of tints will, in a few years, be truly beautiful, if not grand. Should the laburnum be objected to, six rows of the evergreen oaks may be planted, and these would add density to the mass of dark evergreen foliage, which would contrast very finely with the airy spray, and lively green tint of the acacias.

No. 5. The strip, four yards in width, may, with great propriety, be stocked with standard fruit-trees. Thus, seven apple-trees, twenty feet apart, can be planted in the middle of the space; and in front of these, six damson, or six walnut-trees, or three of each, but opposite to the intervals between the apple-trees, and at least five feet in advance of them.

The narrow strip below 5, should not be planted with any trees which could occasion drip, because of its proximity to the garden and orchards; however, it would suit a row of Barberry shrubs, planted at six or seven feet asunder; and if a rill of water were led into the strip, and a quantity of bog earth, or good leaf mould, substituted for the natural soil, an abundant supply of the *cranberry* could be obtained: even the *bilberry*, or whortleberry, might be made to grow, but it should be distant from the water, as it is naturally found growing in peat earth, upon high heath grounds, where water is never known to stagnate.

560. There are many other trees which are suitable to screen-plantations;—such are the hickory, *Juglans alba*; the Spanish or American chesnut, *Fagus Castanea*; the tulip-tree, *Liriodendron tulipifera*; and, though a tree of but humble pretensions, yet one that might be rendered very ornamental as well as serviceable, is the common elder, *Sambucus Nigra*. If this tree be raised from seed it grows with rapidity, and may be taken when two years old into plantation: there, being headed down and kept pruned of its lower shoots, it will produce an erect stem, and a fine head. If none be admitted into the screen, I would recommend that a few rods of ground be set apart for elders, which at first may be planted three feet apart, and, finally, thinned to stand six feet distances, tree from tree.

561. *Future care of the plantation.*—It is acknowledged by all—and some have objected to the “culture system” on that very

account—that the success of a plantation depends greatly upon the care which is bestowed in keeping the ground open in texture, and wholly free from weeds. Pontey observes, “that wherever preparing the soil for planting is thought necessary, that of cultivating it for some years afterwards will generally be thought the same, for where quick growth is essential, cleanliness of appearance is usually of consequence.”

“A plantation ought to be kept as clean as a hop-garden; and, like that of a hop-garden, ought to be dug with a fork every winter. It is best not to dig too early, because the ground runs together in consequence of the quantity of the wet that falls upon it before the spring; late in February or early in March is time enough to dig it. The winds in March dry it through and through, and then the rains in April and May make it fine and light all the summer, easy to hoe, and the weeds easily kept down.”—(*Woodlands*, No. 81.)

## SECTION II.

### PART I.

#### NATURAL HISTORY AND CULTIVATION OF ESCULENT VEGETABLES.

Subject 1. MUSTARD:—*Sinapis*; *Cruciferæ*. Class xv. Order i.  
*Tetradynamia Siliquosa*, of Linnæus.

562. There are two species of the cultivated mustard, both natives of Britain. The genus *Sinapis* ranks among those plants of the order whose “cotyledons are folded and incumbent. The essential generic character is a *pod*, nearly cylindrical; beaked, with two valves. *Seeds* nearly globular. *Calyx* closed.”

563. The WHITE MUSTARD, *Sinapis Alba*, has light green leaves, almost all lyrate, toothed, roughish. *Flowers*, numerous, yellow; *seeds*, rather few, large, pale, yellowish brown. It grows in corn fields, and flowers in June and July. The young herb, when the seed-leaves are fully expanded, and the true leaves, (or plumelet,) have emerged from between them, is used as a salad. The ripe seeds were a few years since recommended to be taken whole, as a tonic and detergent; and the public was amused for a time with the inflated accounts of the medicinal virtues of this stimulant, for debility of the digestive organs.

564. The BLACK MUSTARD, *Sinapis Nigra*. *Flowers*, smaller than those of the foregoing species; *calyx*, yellowish; *seeds*, several, brown. When ground, they produce the common flower of mustard that is used for the table. The plant is extensively cultivated in the Isle of Thanet, in fields, for the London market. "If the seeds," Dr. Cullen observes, "be taken fresh from the plant and ground, the powder has little pungency, but is very bitter; by steeping in vinegar, however, the essential oil is evolved, and the powder becomes extremely pungent. In moistening mustard-powder for the table, it may be remarked, that it makes the best appearance when rich milk is used; but the mixture in this case does not keep good for more than two days."

Subject 2. CRESS, Garden Cress, or Pepper Wort:—*Lepidium Sativum*. Class xv. *Tetradynamia* of Linnæus.

565. *Cress* is one of those plants whose seeds have been denominated *Polycotyledonous*—for the seeds are divided into six lobes. It produces whitish flowers in June and July, and ripens its seeds in the autumn. There are three varieties of the garden cress, all of which are used as salads.

1. The common plane-leaved, chiefly cultivated.
2. The curled-leaved, more handsome as a garnish.
3. The broad-leaved, sometimes used for rearing turkeys.

566. *Cultivation of mustard and cress*.—If the weather be open and mild, the seeds may be sown early in February, in beds and borders of the natural ground; but still it will be prudent to shelter the beds either with a frame and lights, hand-glasses, or a covering of mats placed over hoops stretched across the beds. Select a spot of dry, light earth, dig, and break it well till it becomes very fine, and then rake the surface smooth. Draw some shallow drills with the point of a small stick, or, what may be better, lay a straight thin rod along a line, and press it into the ground, so as to form a groove. In this drill or groove sow the seeds very thick, and sift over them about a quarter of an inch of earth. If protection is to be used apply it directly; give much air as soon as the plants appear, if the weather be fine. These plants are successfully grown on a vinery floor.

567. *About the middle of the month* sow again, and repeat the sowings once in ten days or a fortnight throughout the summer, if salading be in constant request. When the plants, both under cover and in the open ground, begin to come up, they often raise the earth in a kind of cake upon their tops. They may be relieved from it, by

using a small whisk, or light heath broom; this will scatter the earth, and the plants will rise regularly.

When the plants are attacked with hoar frost, water them out of a pot with the rose on, before sun-rise, in order to wash off the rime.

568. *Cress* is more tardy in its growth than mustard, therefore it ought to be sown, three or four days at the least, prior to the sowing of the mustard, which is to be used as salad with it. "When crops are in demand throughout winter, either sow in a moderate hot-bed, or in cradles, to be placed in a stove; pans filled with rotten tan are to be preferred to pots or boxes with mould. From the last fortnight of October till the first of March it will be mostly fruitless to sow in the open garden; but a terrace, sloping south, under a frame, may be used at the decline of the year and most early part of the spring, as the intermediate step between the open garden and hot-bed, if more within the means at command. During this interval, some market-gardeners sow it just within the glasses which cover the larger plants." Both cress and mustard are occasionally raised on porous earthenware pyramids, with gutters or ledges on the sides. They also may be raised on a piece of moistened flannel placed in a dish, and kept very wet. This is one among the many facts that may be brought forward in proof of the conversion of pure water into carbon. Mr. Hume, I believe, says, that he has raised salad upon moistened metallic oxides. Now, although the plant might possibly derive a portion of oxygen from the oxide, from whence could it obtain carbon and hydrogen, unless it were from the water or the metallic base? There is the atmosphere, to be sure, to be taken into consideration; but in all these inquiries we are approaching to, rather than avoiding the conclusion, that air and water agree in their constituents, and that plants derive all their elements from the bases of water.

569. *Saving the seed*.—Reserve a few rows; the plants will flower in June and July, and produce ripe seed-vessels in two or three months. They should then be pulled up, and laid upon large sheets of paper, or a cloth, in a dry, airy barn or shed, till the moisture be wholly exhaled; the seeds may then be rubbed out.

Subject 3. CORN SALAD—LAMB'S LETTUCE:—*Fedia olitoria*, olim, *Valeriana Locusta*; *Valerianææ*. Class iii. Order i. *Triandria Monogynia* of Linnæus.

570. *Corn salad*.—Its essential generic character is—*Flowers*, superior, or above the receptacle. "Corolla, 5-cleft, protuberant at

the base. *Capsule*, crowned with the toothed calyx, without valves, of one to three fertile cells. *Seeds*, solitary." Native, in cornfields and light cultivated ground; lower leaves spatulate, stalked; upper ones sessile, sometimes jagged; flowers pale blue, in round heads, none at the forks of the stem. It flowers from April to June, and produces seed in July and August.—(*Eng. Flora.*)

*Corn salad* is used through the winter, and early in spring, partly as a substitute for small lettuces, and partly to increase the variety of small salad herbs. Loudon says, that it has long been a favourite in France, under the denominations of *mâche*, *douce*, *salade de Chanoine*, and *poule grasse*.

571. *Culture*.—A quarter of an ounce of seed will sow a bed broad-cast, of four feet by five. Sow, first in August, and again in September, for winter salad, and prefer small drills. The plants, when about an inch high, are to be thinned to three or four inches distance. For the summer supply, sow once a month, from March, and cut the crops when they are in a young and tender state, as they are apt to become rank during dry weather. The seeds may be saved and preserved in the manner directed for mustard and cress.

Subject 4. INDIAN CRESS, or NASTURTIUM: — *Tropæoleæ*; *Tropæolum majus*. Class viii. Order i. *Octandria Monogynia* of Linnæus.

Essential generic character is, *calyx*, five-parted. *Corolla*, of five unequal petals, the upper one large, tailed behind. *Seed-vessel*, a three-lobed germen, succeeded by three roundish furrowed berries, with three seeds.

572. *Indian Cress* "is a hardy annual, a native of Peru, introduced in 1686. The stalks, if supported, will rise eight or ten feet high; the leaves are peltate, or have their petiole fixed to the centre of the leaf; the flowers are very showy, of a brilliant orange-colour, and continue in succession from July till destroyed by the frost. In its native country it endures several seasons; but here, being unable to sustain our winter, it is treated as an annual plant, and requires to be sown every year."—(*Enc. Gard.* 416.)

I have however noticed that it will sow itself, and rise year after year, in despite of pulling up and deep digging: to preserve order and regularity of growth, it must doubtless be sown and protected; but the plant furnishes decisive evidence of the hardihood of its seeds, which remain without injury under the surface of the ground, even in rigorous winters. "The flowers and young leaves are fre-

quently eaten in salads: they have a warm taste, like the common cress, thence the name of *nasturtium*. The flowers are also used as a garnish to dishes, in which they form a brilliant contrast with the flowers of borage. The berries are gathered green and pickled, in which state they form an excellent substitute for capers.”—(*Idem*, 411.)

573. *Culture*.—It is raised from seed of the preceding year, of which, one ounce will sow twenty-five feet. Sow, between the middle of March and the end of April, in a little drill. The plants will grow in almost any soil, but a light loam is preferred. As they advance to the height of a few inches, they will require to be supported either by stoutish stakes, or by a light trellis; therefore, it will be best to sow the seed near a fence or railing, against which the plants are to be trained.

The berries may be gathered for pickling when they attain their full growth, but are still in a green and tender state.

574. *To save the seed*.—Leave a number of the berries to attain maturity, which they will do in August and September. Then gather and spread them on sheets of paper to dry.

Subject 5. PARSLEY :—*Apium Petroselinum*; *Umbelliferæ*. Class v.  
Order ii. *Pentandria Digynia* of Linnæus.—*Umbellatæ*.

575. The essential generic character has been described under the article Celery, page 303. “*Parsley* is a hardy biennial, a native of Sardinia, and introduced in 1548. It is so common as to be naturalized in several places of England and Scotland. The root-leaves are compound, and much curled in some varieties. The flowers are pale yellow, and appear in June; they have usually one leaflet at the origin of the universal umbel; and an involucre of from six to eight short folioles, fine almost as hairs to the partial umbel.”—(*Enc. Gard.* 4082.)

576. The *Varieties* are, the common plane-leaved parsley, the curled-leaved, and the broad-leaved Hamburgh parsley. The two first are used as pot-herbs for broths, soups, and sauce, also as a garnish. The third variety, or Hamburgh, is cultivated for its esculent carrot-shaped roots, which are boiled like parsneps. It is in season during the autumn.

577. *Culture of the garden parsley*.—The seed is to be sown in good clean earth, in drills, as edgings to borders or garden plots; or it may be raised in beds in the compartments. The drills are to be made about half an inch deep, and nine inches asunder; the seed is then to be sown regularly, and not very thickly, and covered with

fine earth. The plants will not rise in less than a month or six weeks, as the seeds do not germinate rapidly. One sowing will furnish a supply for a year, or even for sixteen months; but it will always be prudent to sow annually in March, or, as I believe, in November, to come in early in the spring. Then, in June or July, when the plants grow rank and full, they may be cut down nearly to the surface, which will cause them to sprout afresh, full and stocky, and these will continue in perfection during the winter, and till the fresh-sown plants come into season. In July of the second year, they will shoot up for flower, and produce ripe seeds in the autumn.

578. *Cultivation of the Hamburgh parsley.*—Dig a piece of light ground in an open situation. Sow the seed thinly and regularly, either in shallow drills eight or nine inches apart, or broad-cast over the surface; and rake it in, making the earth of the bed level, by patting it gently with the back of the spade. When the plants attain the height of two or three inches, thin them out till they stand six inches asunder at the least. Keep the beds free from weeds, and the roots will grow to a considerable size by the autumn, and continue fit for use during the winter.

## PART II.

### OPERATIONS IN THE VEGETABLE GARDEN, FOR THE MONTH OF OCTOBER.

579. *Sow*—small salading (568); lettuces (484); radish, &c.; in the first week.

*Mazagan beans* (22); peas, the early frame; at the end of the month.

*Plant*—slips of many kinds of the sweet herbs; early in the month.

*Transplant*—endive (489); lettuce (483); into warm borders.

*Early York cabbage* (111); about the middle or latter end.

A few fine roots of beet, carrot (74), and parsnep; to produce seed.

*Dig up* carrots, parsneps, beet, Hamburgh parsley; a few roots for early supply, or to preserve in sand. Potatoes, the winter stock, for pitting (211, 212), or storing in dry cellars or sheds.

*Earth up* celery in the trenches; and endive, as directed at (490), to blanch it.

Clear from weeds, the beds of winter spinach, lettuce, broccoli,

cabbages, &c. ; and dig lightly, and draw earth to the stems of all the *brassica* tribe.

Hoe, rake, destroy weeds, remove litter of every kind.

*Prepare to protect*, by arching over with hoops, &c., those beds or patches of tender crops which are to be covered with mats or tarpauling during frosty and severe weather.

### SECTION III.

#### PART I.

#### NATURAL HISTORY AND CULTIVATION OF BERRIED FRUITS

Subject 1. The STRAWBERRY :—*Fragaria* ; *Rosaceæ*. Class xii.  
Order iii. *Icosandria Polygynia* of Linnæus.

580. The essential generic character of the genus *Fragaria* is, according to *The English Flora*, “*Calyx*, 10-cleft. *Seeds*, naked, even, on the surface of a pulpy, deciduous *receptacle*.” The native species are two in number :—

First. *Fragaria vesca*, wood strawberry. *Root*, rather woody, blackish, with many fibres, sending out many runners. *Stems*, four or five inches high, with soft spreading hairs. *Leaves*, mostly radical, that is, not attached to the ascending flower stem ; two lateral leaflets, unequal at the base. *Flowers*, erect, white ; *footstalks*, hairy. *Fruit*, drooping, deep scarlet.

Second. *Fragaria elatior*, hautboy strawberry. More hairy in every part ; the essential difference consists in the long, or deflexed hairs of all the flower-stalks as well as foot-stalks. *Flowers*, white generally, but not always ; imperfectly dioecious ; those on one plant having chiefly the stamens perfect, whilst another bears the most complete pistils. The *fruit* in the true hautboy, (*haut*, high, elevated ; *bois*, wood,) known by its larger size, dark hue, and peculiar musky flavor. Dr. Smith observes, that he has never *seen* it wild, but he says that it is found “in a wood to the west of Tring, Hertfordshire, certainly wild, and in Charlton forest, Sussex.”—(*English Flora*, *Fragaria*, Vol. II.)

The cultivated species or varieties are thus noticed in the *Ency-*

*clopædia of Gardening*. “Knight (*Hort. Trans.*, Vol. III., 207,) considers the *grandiflora*, or pine, the *Chiloensis*, or Chili, and the *Virginiana*, or common scarlet, (the first supposed to be a native of Surinam, the second of Chili, and the third of Virginia,) to be varieties only of one species; as all may be made to breed together indiscriminately. The fruit has received its name from the ancient practice of laying straw between the rows, which keeps the ground moist, and the fruit clean. They are natives of temperate or cold climates, as of Europe and America. The fruit, though termed a berry, is, in correct botanical language, a fleshy receptacle.” (4712.)

581. The *species or varieties* are:—

The scarlet (*F. Virginiana*), fruit roundish, scarlet coloured.

The roseberry (*F. Virg. var.*), larger, and very prolific.

The Downton (*F. Virg. var.*), large, irregular, cockscomb-like.

The Carolina (*F. Caroliniensis*), red.

The Chili (*F. Chiloensis*), whitish.

Keen's Imperial, or new Chili (*F. Chil. var.*), a large showy fruit,—“Keen's seedling.”

The pine (*F. Grandiflora*),—the red and the white, or greenish tinted, rich flavoured.

The Alpine, or prolific (*F. Collina*), bears from June to November; two sorts, the white and the red.

The one-leaved (*F. Monophylla*), the pulp of the fruit pink-coloured, a native of South America.

The Elton, Knight's seedling, long, conical, deep scarlet.

582. *Propagation*.—The strawberry increases every year by suckers from the parent root, and also by protruding abundance of runners, which extend in all directions, and take root at every joint or bud. Of these suckers and runners, new plantations are formed either in August, September, October, or March. It only remains to ascertain the readiest and best method of propagation, in order to ensure the most abundant produce of the finest fruit,—and I shall, therefore, according to the plan I have heretofore pursued, adduce several good authorities; but as it is now admitted that the strawberry termed “Keen's seedling,” and that known by the name of the “pine,” are the favourites of the day,—and as Mr. Keen, nurseryman at Isleworth, has published particular directions for the cultivation of his strawberry, I shall copy them at length, in the belief that by referring to the authority of the first cultivator of the then period (1829), I shall not only simplify the directions, but enable the domestic gardener to commence his operations with the greater confidence of ultimate success.

583. *Site and Soil, according to Harrison*.—“The strawberry should always have an open situation, well exposed to the sun and air; and a light rich loam to the depth of twenty inches at least. I always find that strawberries succeed the best when planted in single rows. The season which I prefer for planting is the spring,

generally about the end of March, varying according to the season. The soil in which they are to be planted should be enriched with well-rotted manure (cow's dung is what I prefer) more or less, according to the kind of strawberry to be planted; the pine, imperial, and the strong-growing kinds, must not have so much manure by a great deal as the roseberry, boss-stock, hautboy, and the less vigorous sorts, because too much manure causes the former to run into leaf."

584. *Mr. Keen's general directions.*—He says—"I will commence with a general detail of my practice; this may be considered as applicable to all the varieties of the strawberry; and afterwards, in noticing each kind that I cultivate, I will specify such peculiarities of treatment as are exclusively applicable to each.

585. *In preparing the soil for strawberries.*—"If it be new, and, as is frequently the case, very stiff, it should be trenched; but if the bottom spit of soil, as sometimes happens, be of an inferior quality, I then recommend only a simple digging, placing dung at the bottom underneath the mould so dug; on the contrary, should the land have been kept in a high state of cultivation, or be good to the full depth, it will be advisable for the bottom spit to be brought up to the top, placing the dung between the two spits. The best way to obtain new plants is, by planting out runners in a nursery, for the express purpose, in the previous season; for it is a very bad plan to supply a new plantation from old plants. With respect to the time of planting, I have always found the month of March better than any other. Sometimes, when my crops have failed, I have had runners planted in the autumn, for the following year, but these have always disappointed my expectations. I plant them in beds, containing three or four rows, and the plants in each row at a certain distance from each other, leaving an alley between each bed, the distance between the rows and the plants in the rows, as well as the width of the alleys, depending on the kind of the strawberry to be planted.

586. *General culture.*—"After the beds are planted, I always keep them as clear of weeds as possible, and on no account allow any crop to be planted between the rows. In the autumn I always have the rows dug between, for I find it refreshes the plants materially; and I recommend to scatter in the spring, very lightly, some loose straw or dung between the rows. It serves to keep the ground moist, enriches the strawberry, and forms a clean bed for the trusses of fruit to lie upon. A short time before the fruit ripens, I always cut off the runners to strengthen the root, and after the fruit is gathered, I have what fresh runners have been made taken off with a reaping-hook, together with the outside leaves around the main plant; after

which I rake the beds, then hoe them, and rake them again. In the autumn, unless the plants appear very strong, I have some dung dug in between the rows, but if they are very luxuriant the dung is not required; for in some rich soils it would cause the plants to turn nearly all to leaf. I also have to remark, that the dung used for manure should not be too far spent; fresh dung from the stable-door is preferable to spit-dung, which many persons are so fond of."

587. *Particular culture.*—The *Pine* grows in a light loam, though no other kind of strawberry will bear a strong loam better than this. Particular care must be taken that they are planted in open ground, for in a small garden they grow very strong, but seldom bear much fruit, in consequence of being so much shaded. In planting the beds of pines, I keep the rows two feet apart, and put the plants eighteen inches from each other in the row, leaving alleys of three feet wide between each bed: these large distances I find necessary, for the trusses of fruit in my garden ground are frequently a foot long. The duration of this strawberry with me, is three years: the first year it bears the best, the second year the crop is very good, and the third year it is less.

588. *The imperial strawberry*—which was raised by myself from seed, may be treated in a similar way, with respect to planting, distance, &c. as the pine, but I have to remark, that it requires rather a lighter and richer soil, and is not so liable to run to leaf when planted under trees.

589. *The hautboy* "I have always found to thrive best in a light soil: and it must be well supplied with dung, for excess of manure does not drive it into leaf like the pine-strawberry." (The same distances are directed as for the pine.) "There are many different sorts of hautboys; one has the male and female organs in the same blossom, and bears very freely; but that which I most approve is the one which contains the male organs in one blossom, and the female in another; this bears fruit of the finest colour, and of far superior flavour. Care must be taken that there are not too many male plants among them: I consider one male to ten females the proper proportion for an abundant crop. I learned the necessity of mixing the male plants with the others, by experience, in 1809; I had before that period selected female plants only for my beds, and was entirely disappointed in my hopes of a crop. In that year, suspecting my error, I obtained some male blossoms, which I placed in a bottle on the bed of female hautboys. In a few days, I perceived the fruit near the bottle to swell; on this observation, I procured more male blossoms, and in like manner placed them in bottles, in different parts of the beds, removing the bottles to fresh places every morning, and

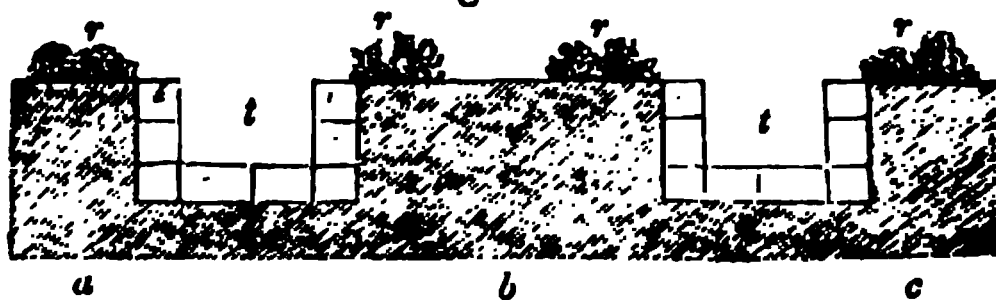
by this means obtained a moderate crop, where I had gathered no fruit the preceding year. The duration of the hautboy, with me, seldom exceeds three years."

In the foregoing extract from Loudon's *Encyclopædia*, No. 4717, &c., I have omitted the author's description of his method of cultivating the scarlet, wood, and alpine strawberries, as not differing materially from that of the other more valuable species.

590. *Trench method of culture.*—In the *Horticultural Transactions*, a method of cultivation is fully described, which I think will be found worthy of attention and repeated trials. It was observed to be practised in a small garden near Chatham. "The beds were upon flat ground, each about three feet wide, and between them were trenches about nine inches wide, and four-inch walls of brick on each side of the trenches, to keep up the earth on the sides of the beds. These trenches were about the depth of two or three courses of bricks laid flat, without mortar, and were intended for the purpose of holding water, which was supplied from a pump whenever the ground was dry, while the plants were in fruit. By this method, a much greater crop of fruit was obtained, and the plants continued much longer, than in beds where there were no trenches for water." —(*Encyc. of Gard.*, 4728.)

The plan may be understood by referring to the annexed figure 30, where *a*, *b*, *c*, represent the soil; *a*, *c*, being sections of a portion

Fig. 30.



of two beds, and *b*, a section of an entire bed, three feet broad wherein rows of strawberries, extending to any given length, are planted. These rows *r*, *r*, *r*, *r*, are about eighteen inches apart: *t* are the trenches, the sides and bottoms of which are lined with bricks; the open spaces at *t*, and *t*, are about nine inches wide. If the expense of bricks were objected to, it might be worth while to try a mode of culture by means of trenches, nine inches wide out exactly like those prepared for celery, No. 365. The earth of the trenches should be thrown upon the beds, and these could be at least three feet broad. In all other respects, the description might be attended to, and probably, with corresponding

591. *The strawberry plant may be renewed*, and successfully, too, I am persuaded, notwithstanding all that has been said to the contrary, by simply taking up the three years' old plants in March, and carefully pruning off the greater part of the old woody roots, and all those brown fibres of the former year, which have become inert. In taking up a plant, two sets of roots will often be discernible. One consists of those woody, brown fibres just alluded to,—the other of a few fibres of a paler hue. The former were the organs of nutrition to the system of leaves and the parts of fructification of the last summer; the latter are the vital organs of the newly developed central parts that will produce fruit in the ensuing season. I by no means would recommend this method of propagation, as a substitute for that of multiplying by strong runners; but where it is an object to obtain a considerable supply of an approved fruit, during the first summer after planting, I think a bed or two might advantageously be formed from the old bearers thus renewed. I have practised the method partially, and successfully; and once, in the spring, I removed a great part of my plants, even without pruning the roots, planted them in other situations, and had a prodigious supply of strawberries from Midsummer to the end of July.

Experience has subsequently taught me, that the following is the best method of increasing the plant; because it includes regularity, precision, and certainty of species or variety. By it, also, the plants intended to be forced, in pots, are very successfully prepared.

*Propagation for forcing, &c.*—When the runners form, and begin to develope young plants, with root-processes, let a quantity of rich turfy loam, (unctuous, yet light in texture,) be made ready; and to it, add one-third part of decayed leaves and stable-manure, from linings or hot-beds. The materials being chopped and blended together, turned, and re-mixed, several times during a week, should lie in a heap, till the time of potting. Prepare a number of pots, (forty-eights, or large sixties,) each with an oyster-shell, or a piece of pot over the hole, and a half-inch layer of soot and ashes. Fill the pots with the prepared loam, and plunge each near plants of known fruitful kinds, in a position where a runner-plant may reach the centre of each. Press the roots firmly into the soil, and lay a stone, or bit of brick on the string, close to the young plant, to keep it steady in its pot. Strict attention to watering is required; and if the soil be always kept free from drought, the roots will speedily fill the pot, and render the plant completely independent of its parent; then it must be detached, and the pots placed in a north aspect, where water should be near, to keep the plants constantly growing.

By this means a stock, not only of *Keen's seedlings*, for forcing,

may be collected; but of every other approved variety raised for the garden; these are to be transferred to borders, or beds, of rich, light, and deeply-worked soil, in September. It will prove very advantageous, to prepare plants every year; and to pinch off every blossom which may show, in the following, or first spring. The quantity of fruit in the second year will thus be greatly increased.

592. *Cutting off the old leaves in August.*—This practice is blamed by many gardeners; nevertheless, I believe that it may be considered a matter of indifference as far as concerns the fruiting of the plant, that is, provided the old leaves alone—those of the spring's growth—are taken off, because they never will again become active organs of nutrition. But as they afford some protection to the root during winter, I think that Harrison is right, when he observes—"I find that the plants do best when the tops are left upon them until spring, as the leaves protect the roots from the severity of frost during winter; and when they are taken off at autumn, I never could discover that the plants were strengthened by it, but were thus exposed to all the severity of winter:" and, therefore, he adds,—“At the following spring, about the end of March, when the severe frosts are over for that season, let all the old tops be cut clean off.”

593. *Raising from seed.*—The same author says,—“The method I practise with them is to gather the fruit, and spread them open in the sun for a day or two, then wash the seeds out, and immediately sow them in a bed of rich light soil. As soon as the plants are big enough to transplant, I prick them out at three inches apart, in some other beds of rich soil. At the following spring, I finally plant them off, and they will sometimes bear well the first year.”—(*Treatise on Fruit Trees*, 307.)

Subject 2.—THE CRANBERRY:—*Oxycoccus palustris*; *Erica*.

Class viii. Order i. *Octandria Monogynia*, of Linnæus.

594. The essential generic character, of the genus *Vaccinium*, from which this plant is now removed, is—*Corolla*, of one petal. *Calyx*, 4-cleft. *Berry*, inferior. The specific description of our native species, *V. Oxycoccus*, (from *Oξύς*, acid, sharp, and *Κόκκος*, a berry, or grain,) is “*Roots* creeping with many long fibres. *Stems* slender, wiry, trailing, and creeping, with numerous leafy branches. *Leaves* alternate, erect, on short stalks, small, perennial, convex, rigid; glaucous underneath. *Flowers* very elegant, (reddish white,) “drooping on simple, red stalks, several together at the end of each branch, and bearing a few scattered bracteas. *Corolla* divided

nearly to the bottom, in four oblong, reflexed segments. *Filaments* downy. *Anthers* with two long tubular points, but no horns. *Berries* spotted, in an early state, finally deep red, very acid, highly grateful to most people, in tarts, or other preparations, with sugar; though in Sweden, they serve only for an acid liquor to boil silver plate in, to eat away the minute external particles of the copper alloy.—(SMITH'S *Flora*.)

*Oxycoccus*.—" *Calyx*, 4-cleft; *Corolla*, 4-parted; with linear, revolute segments; *Filaments* conniving; *Anthers* tubular; *Berry*, many-seeded;" compare these characters of the two nearly allied genera.

595. The *American Cranberry*, (*Oxycoccus macrocarpus*; from *μακρὸς*, large, and *καρπὸς*, a fruit,) "is a native of North America, and, by the ingenuity of Sir Joseph Banks, it may be said to be now added to our cultivated fruits. A very interesting account of the mode adopted by that illustrious horticulturist, is given by himself in the *Hort. Trans.*, Vol. I., 71, and of the produce, which was large and uniform. In one year, viz., 1813, from three hundred and twenty-six square feet, or a bed about eighteen feet square, three and a-half Winchester bushels of berries were produced, which, at five bottles to the gallon, gives one hundred and forty bottles, each sufficient for one cranberry-pie, from two and a-half square feet."

596. *Cultivation*.—As the cranberry is a native of turfy bogs and mosses, it should be planted in peat-earth, or pure leaf-mould, intermixed with some white siliceous sand, and probably with a considerable quantity of moss, which would gradually decay, and become fine peat-earth. I have not had an opportunity of growing the cranberry-plant, but am persuaded that both species may be cultivated alike, and be rendered very profitable crops. "Wherever there is a pond," Neill observes, "the margin may, at a trifling expense, be fitted for the culture of this plant, and it will continue productive for many years."—"The cranberry will succeed when planted as an edging to any pond, provided some bog-earth be placed for its roots to run in; or if a bed of bog-earth be sunk in any shady situation, so as its surface may be a few inches below the general level, for the sake of retaining water, the plant will thrive well, and being regularly watered in the driest weather, produce abundant crops."

597. *Culture of dry beds*.—"The American cranberry," Salisbury observes, (*Hort. Trans.* II. 96,) "may be cultivated very successfully in situations not positively wet, if only planted in bog-earth, which retains moisture longer than any other soil; for a few plants

even in pots, which had stood some time neglected under a hedge, so that their branches were matted together, produced a plentiful crop. Hallett found the cranberry, and also the bilberry, succeed perfectly in a dry bed of peat-earth, so that it may now be cultivated in any garden where that soil can be procured, (*Hort. Trans.*, IV. 483.) Milne also found vigorous shoots, and abundant crops produced on dry beds of peat-earth, even in the dry summer of 1822. He finds the American cranberry easier cultivated than the common; but some prefer the flavour of the latter."—(*Hort. Trans.*, V. 279.—See *Encyc. of Gard.*—'Cranberry,' 4708, *et seq.*)

J. W. Oldacre, when gardener to the late Sir Joseph Banks, at Spring Grove, cultivated the cranberry with success. He assured me, that by giving a top-dressing annually, of heath, or bog-soil, almost burying the straggling shoots, the plants prospered; but a very moist situation, near water, appeared a desideratum.

In 1831, I prepared a bed for the express purpose, with decayed turf, pit sand, and leaf-mould, not then being able to command a supply of heath-soil; but though the plants lived, they never thrived; and could not easily be replaced. I never yet saw a plant in any collection.

## PART II.

### OPERATIONS IN THE FRUIT DEPARTMENT.

598. *Plant* fruit-trees in general, if their leaves have fallen; but this will rarely be the case, except in the instance of currant-trees.

*Pruning* may be commenced; but I think it would generally be prudent to confine the pruning to *cutting out*, deferring *shortening* till the approach of spring.

*Fruits*—gather and dry them thoroughly; wipe apples, and place them on shelves in a dry, airy, fruit-room. Sand was strongly recommended, but not judiciously.

*Prepare ground* for new plantations; manure, and dig the beds and plots after the trees have been pruned.

### MISCELLANEOUS.

599. *Sow*—in warm borders, larkspurs, adonis, heart's ease, perisaria, &c.

*Plant*—some bulbs towards the end of the month; also, many herbaceous biennials and perennials, in the plots, borders; and in nursery departments, where they may be protected by mats.

*Dig over* the flower-borders with a fork ; raise and trim herbaceous plants, removing redundant offsets and suckers, then re-plant them in due order. Observe regularity and neatness, in every operation.

Box edgings may be cut, and hedges clipped.

The *flower-garden* and *shrubbery* retain a few only of those ornaments which were mentioned in the catalogue of select plants of the last month. Here and there a China-rose, some of the Michaelmas daises (*Aster*), and occasionally, the laurustinus may be seen in flower. *Symphoria racemosa*, or snow-berry, a shrub of the most easy culture, now exhibits its elegant bunches of white berries in full perfection. The *Chrysanthemum indicum*, ought to be progressing to flower, but the frosts of late years have rendered every October very unpropitious.

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## THE NATURALISTS' CALENDAR.

## OCTOBER.

THE weather during this month is sometimes fine, calm, and serene, and when it is so, October, is a very beautiful month. The heat is occasionally considerable, the thermometer standing at from 60 to 65°; and if this be coincident with the perfect calm and mistiness that characterize the month, it becomes very oppressive. This is the season for the *gossamer*, which abounds most when the weather is dry and serene. A remarkable phenomenon is related by the late Mr. White, in his *History of Selborne*. It occurred on the 21st of September, 1741, old style—a day which the author describes as “one of those most lovely ones that no season but the autumn produces—cloudless, calm, serene, and worthy of the South of France itself.”

“About nine, an appearance very unusual, began to demand our attention, a shower of cobwebs falling from very elevated regions, and continuing without any interruption till the close of day. These webs were not single, filmy threads, floating in all directions, but perfect flakes or rags—some near an inch broad, and five or six long. On every side, as the observer turned his eyes, might he behold a continual succession of fresh flakes falling into his sight, and twinkling like stars, as they turned their sides towards the sun. Neither before nor after was any such shower observed; but on this day, the flakes hung in the trees and hedges so thick, that a diligent person might have gathered baskets full.”—(Vol. I., p. 326.)

The average height of the Barometer is about 29 in. 55 cts.

Ditto of the Thermometer, about 50 degs. 85 cts.

*In the first week.*—Swallows (*Hirundo rustica*) congregate, and sometimes disappear.

*Second week.*—Redwing (*Turdus iliacus*), fieldfare (*Turdus pilaris*) return; martins (*Hirundo urbica*) migrate, or disappear; hen chaffinches (*Fringilla cœlebs*) congregate.

*Third or fourth week.*—Gossamer abounds; Royston, or hooded crow (*Corvus cornix*), snipe (*Scolopax gallinago*) return; rooks (*Corvus frugilegus*) return to their nests; wood-pigeons (*Columba palumba*) arrive.

# NOVEMBER.

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## SECTION I.

### SCIENCE OF GARDENING.

#### SCIENTIFIC OPERATIONS OF GARDENING.

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THESE operations include all the mechanical or artificial processes, by which plants are propagated, reared, and trained;—those by which their fertility is increased, accelerated, or retarded;—and, finally, those chemical processes, by which the food of plants is prepared, altered, or distributed. In the preceding sections, much has been already said on the laboration and distribution of vegetable aliment. The present section will, therefore, be devoted to a consideration of the operations connected with the arts of propagation and culture.

#### PART I.

##### OPERATIONS OF PROPAGATION.

##### 1. BY SEED.

600. *Quality of the Seed.*—In order to secure a perfect plant, one that, in every respect, corresponds with the essential characters which distinguish the individual—the seed must be true to its kind, and free from admixture or spurious impregnation. It is a fact, the truth of which, the experience of ages, and that of every observant gardener, tends fully to establish, that congenerous plants are exceedingly liable to become crossed by intermixture; insomuch, that it may be laid down as a sound practical rule—never, in the same year, to attempt to procure perfect seeds from two or more plants of the same tribe, in any garden, be its dimensions what they may, unless the flowers of one of the plants have fallen or withered before those of the others appear.

601. *Inquiry into the cause of intermixture.*—The reader is

referred to what has been already advanced on the subject of impregnation by means of the pollen or farina, at No. 252. To these remarks, I add the following observations of Keith, on the authority of Du-Hamel, and other philosophers:—

“The individual particles of the pollen are themselves organized substances, as may be seen by a good microscope, each particle consisting of a thin and membranous bag, capable of resisting the action of air, but extremely susceptible to the action of moisture, which as soon as it meets with, it explodes, like the anther itself, discharging a fine and subtile vapour, or a sort of fluid, in which there are contained globules still smaller.

“Gærtner describes the globules of pollen as consisting of the following parts:—1st. An external cuticle, sometimes smooth, and sometimes set with hairs;—2nd. A cellular substance;—3rd. A parenchyma, contained in the cells, and seemingly a rude and unorganized mass of granular matter. The globules, if put into water, swell and burst; first the cuticle, then the interior cells, and then the parenchyma, exploding and emitting a subtile and elastic vapour, or sort of fovilla, which swims on the surface. But the phenomenon does not take place in oil.

“Koelreuter describes each globule as consisting of two distinct membranes, an outer and an inner membrane, containing a cellular mass, from which a thin, oily, and inflammable fluid slowly exudes when placed in water, forming a shining and conspicuous pellicle that floats on the surface.”

602. *Whatever may be the internal structure of the farina*, its powers of impregnation appear to depend solely upon specific affinities, acting through the medium of the membrane, which forms its exterior envelope. Thus, when the particles alight upon appropriate organs, such as the stigmas of congenerous plants, they affect those specific impregnations, which, in many tribes—particularly in that of *brassica*—are productive of endless crossings, re-crossings, and of a corresponding number of varieties.

Such plants as have few congeners—as the parsnep, carrot, rhubarb, asparagus, sea-kale, kidney-bean, artichoke, &c.—may be safely cultivated for raising seed; but great caution is required in all cases where plants abound in varieties. But, independently of the danger of intermixture, there is another point which merits much attention. It is this:—Seeds ripened year after year, in the same soil and situation, appear to deteriorate; they produce plants of inferior quality; and for this reason the farmer purchases his seed-corn in quarters far remote from those wherein he intends to cultivate his crops. From whatever cause, therefore, this deterioration

may proceed, it will be prudent not to raise seed of any kind, year after year, from the same stock, but to purchase or exchange seeds of annual and biennial plants every other year, in order to keep up a supply of perfect vegetables.

603. *Agency of the pollen in the work of impregnation.*—While speaking of the subject of intermixture, it will be interesting to inquire further into the philosophy of impregnation by the agency of the pollen, or *farina fructicans*. On this curious inquiry, the reader is referred to the sixth chapter of KEITH'S *Physiological Botany*, vol. ii., page 297. I now extract from the same work, the substance of the following observations, in order to furnish a concise view of the several theories of fecundation that have been advanced by some eminent naturalists. Of these, the principal are:—

(1.) *Theory of the ovarist.*—The term is to be traced to the Latin word *ovum*, an egg; and the theory supposes that “*the embryo pre-exists in the ovary, and is fecundated by the agency of the pollen, as transmitted to it through the style.*” The theory appears to have been supported by Grew, Bonnet, Gærtner, and Haller; but has been most clearly elucidated by Spallanzani, an eminent Italian naturalist, who died in 1798. He chose for the subject of his observations, the Spanish broom—*Spartium junceum*—and commenced them when the flower-buds were not expanded. “When the pistil was freed from the surrounding integuments, and attentively viewed with a good glass, the pod was discovered of about one-tenth line in length. Several protuberances were seen upon its sides, which, upon opening it longitudinally, were found to be occasioned by seeds, which, though but small globules, were already discoverable, arranged in their natural order, and attached by filaments, to the interior of the pod. Upon dissection, they did not exhibit any appearance of the several parts and membranes into which the mature seed may be divided,—but a spongy homogeneous mass. Flowers in the same state of forwardness were not fully expanded, till twenty days after. On dissecting buds of a larger size, the petals were found to be somewhat yellowish, and less compact; and the powder of the anthers was thrown out by the slightest agitation; but the lobes” (*cotyledons*) “and plantlet were not yet perceptible in the seeds.

“On the eleventh day after the flowers had fallen—that is, after impregnation had taken place—the seeds, which were formerly globular, began to assume the figure of a heart, attached to the pod by the basis, and exhibiting the appearance of a white point towards the apex; and when the heart was cut open longitudinally,

the white point proved to be a small cavity enclosing a drop of liquid.

“In forty days after the flower had fallen, the cavity was quite filled up with a body that had been generated within it, and which was now found to consist of a thin and tender membrane enveloping the two seed-lobes, between which the plantlet attached to the lower extremity was also perceptible. And hence, the seed was now visibly complete in all its parts.”

(2.) *Theory of the Animalculist*.—This was founded upon the animal theory of Leuwenhoeck, and transferred to the generative production of vegetables by Morland, Needham, Gleichen, and others, who regard the pollen as being a congeries of seminal plants, one of which at least must be conveyed to the ovary entire, before it can become prolific.

Spallanzani could not detect any appearance of an embryo in the pollen, even by the highest magnifying powers; and, moreover, the well-known fact that “the total want of a passage in most styles, fit to conduct the particles of pollen entire, exposes this theory to the most serious objections. If the embryo is to pre-exist at all, is it not more likely that it should pre-exist in the ovary, where it is to be brought to maturity, than that it should first be generated in one organ or plant, and then transferred to another, to be developed?”—(KERN, Vol. ii. p. 362.)

(3.) *Theory of the Epigenesist*.—The term is derived from the Greek words *επι*, *epi*, which expresses contact, continuity, and co-existence; and *γενεσις*, *genesis*, a creation or production:—and the theory maintains that “the embryo pre-exists neither in the ovary nor in the pollen, but is generated by the union of the fecundating principles of the male and female organs, the former being the fluid issuing from the pollen when it explodes; and the latter, the fluid that exudes from the surface of the stigma when mature.” This theory is supported by Koelreuter, who adduces in particular the result of his experiment on two species of the tobacco-plant—*Nicotiana rustica* and *paniculata*. “A flower of the former species was deprived of all its stamina, and fecundated with pollen from a plant of the latter species. The plant raised from the seed thus obtained, was a hybrid, exhibiting in all its parts an intermediate character betwixt the two species from which it sprang. The stamens of this hybrid, as well as of all others he ever raised, were imperfect; but when its pistils were impregnated with pollen from the *paniculata*, as before, the new hybrid obtained from the seeds now produced was more like a *paniculata* than formerly; and when the experiment was continued through several successive

generations, it was at last converted into a perfect *paniculata*.”—(KEITH, Vol. ii. 365.)

604. *The electrical theory* appears to me to combine, and thus to substantiate, the hypothesis of the ovarist and the epigenesist: for it presumes, that as the integument or external membrane of the seed, and its homogeneous pulp, are found to pre-exist in the unimpregnated ovary, the attraction exerted between the fluids of the *pollen* and those of the *stigma*, through the medium of the membranous covering of the pollen when it alights on the stigma, produces those specific combinations which fertilize the heretofore passive ovary, and induce the formation and developement of the embryo and plantlet. Some interesting facts connected with the subject, and leading to practical utility, remain to be mentioned: they prove to a demonstration, the active agency of the farina.

605. *Mr. Knight's celebrated experiment on the Pea*.—Mr. Knight, in the year 1787, had a degenerate sort of pea growing in his garden, which was not restorable by attention and culture. “Being thus a good subject of experiment, the male organs of a dozen of its immature blossoms were destroyed, and the female organs left entire. When the blossoms had attained their mature state, the pollen of a very large and luxuriant gray pea was introduced into the one half of them, but not into the other. The pods of both grew equally; but the seeds of the half that was unimpregnated withered away, without having augmented beyond the size to which they had attained before the blossoms expanded. The seeds of the other half were augmented and matured as in the ordinary process of impregnation, and exhibited no perceptible difference from those of other plants of the same variety—perhaps because the external covering of the seed was furnished entirely by the female. But when they were made to vegetate in the succeeding spring, the effect of the experiment was obvious. The plants rose with great luxuriance, indicating in their stem, leaves, and fruit, the influence of this artificial impregnation: the seeds produced were of a dark gray. By impregnating the flowers of this variety with the pollen of others, the colour was again changed, and new varieties obtained, superior in every respect to the original on which the experiment was first made, and attaining in some cases to a height of more than twelve feet.”—(*Phil. Trans.* 1789.)

606. *In experiments upon the apple-tree* Mr. Knight's success was also decisive. (See No. 38, page 44.) “The plants which were obtained in this case were found to possess the good qualities of both varieties employed, uniting the greatest health and luxuriance, with the finest and best flavoured fruit.” (*Phil. Trans.* 1799.)

Mr. Knight concludes, that “promiscuous impregnation of species has been intended by nature to take place, for the purpose of correcting such accidental varieties as arise from seed, and of confining them within narrow limits.” “But although he admits the existence of vegetable hybrids—that is, of varieties obtained from the intermixture of different species of the same genus; yet he does not admit the existence of vegetable mules—that is, of varieties obtained from the intermixture of the species of different genera; in attempting to obtain which, he could never succeed, in spite of all his efforts.”—(KEITH, Vol. ii. 370.)

607. *Maturity of the seed.*—Perfect maturity is, in general, indispensably required to ensure successful results; nevertheless, there are a few seeds that have been known to germinate when in an unripe state. Thus, Keith observes, that he has often known the germination of the radish to be effected in the pods, when they have been allowed to remain after the usual period of gathering. Peas, too, he says, have been known to sprout when sown in a green and soft state; and a lemon-seed he observed to send out a radicle an inch and a half long; and a plumlet visible to the naked eye before it was yet extricated from the fruit. But these are exceptions—and rare ones—to the rule, which requires that all seeds be in a perfectly mature state in order to secure a crop: they ought also to be sound, and the finest of their kind. To produce such fine and mature seed, the gardener should select the first and earliest seed-vessels; or—what I believe is better—he ought to sow or plant expressly for seeds, and at a comparatively early period; for, as light is the primo agent in effecting the maturity of fruits, those seed-vessels will be found in the highest state of perfection which have received the greatest proportion of the solar rays; therefore—all other circumstances being propitious—those early plants, whose organs of fructification expand during the month of June, and ripen under the influence of the midsummer sun, will be more mature than others, which having been sown or planted late, have not developed their flowers until August or September.

608. *Mature seeds, if preserved from damp*, will retain their germinating power for a certain period of time, beyond which it will not in general be safe to depend upon them. The *Encyclopædia of Gardening* furnishes a list of the several periods at which many seeds may be expected to grow freely.

*Cabbage-tribe*, four years.

*Leguminous culinary vegetables*, one year.

*Esculent Roots.*—Turnip, four years;

carrot, parsnep, one year; radish, salsify, two years; skirret, four years; scorzonera, two years.

*Spinaceous Plants.*—Spinage, four

years; white beet, ten years; purslane, two years; orache, herb patience, one year.

*Alliaceous plants*, two years.

*Asparaginous Plants*.—Asparagus, four years; sea-kale, artichoke, three years; cardoon, rampion, alisanders, and thistles, two years.

*Acetarious plants*, in general, two years; endive, four years; lettuce, three years; burnet, six years; mustard, four years; tarragon, four years; sorrel, seven years; celery, ten years.

*Pot-herbs and garnishing plants*, in general, two years; but parsley will grow at six years; dill and fennel, five years; chervil, six years; marigold, three years; borage, four years.

*Sweet herbs*, generally two years; but rice and rosemary, three years; hyssop, six years.

*Plants used in tarts, &c.*, generally two years; but rhubarb, only one year; and gourd, pompion, &c. ten years.

*Herbaceous Fruits*.—The cucumber and melon, ten or more years; love-apple, capsicum, and egg-plant, two years.

*Annual and biennial flower-seeds*, generally two years; but some will grow, with difficulty, the second year; they are seldom kept by seedsmen longer than one year.

*Perennial flower-seeds*, the same.

*Tree-seeds*.—Stones, two years; and some, as the haw, three; but they are in general of very doubtful success the second year; acorns will scarcely grow the second year; elm, poplar, and willow seeds, not at all.

To this list may be added *Indian corn*, which, it is said, will germinate after 100 years.

609. “*All seeds ought to be kept dry, and the air as much as possible excluded*; but those liable to be attacked by insects, as the pea, bean, turnip, radish, &c. should be occasionally exposed to air and friction, by being passed through a winnowing machine. The more rare seeds should be kept in their pods till the season of sowing.”—(*Enc. Gard.*, 7485-6.) I suggest that when the smaller seeds are freed from their husks, and are become perfectly dry, they would be most effectually preserved by being kept in glass wide-mouthed bottles, corked, or tied over with bladder.

610. *Philosophical inquiry. Do all plants spring originally from seeds?*—Keith regards it as an indubitable fact that such is their origin. He says that “most seeds, if guarded from external injury, will retain their germinating faculty for a period of many years. This has been proved by the experiment of sowing seeds that have been long so kept; as well as by the deep ploughing up of fields that have been long left without cultivation. A field that was ploughed up near Dunkeld, in Scotland, after a period of forty years’ rest, yielded a considerable blade of black oats, without sowing. It could have been,” he adds, “only by the plough’s bringing up to the surface, seeds that had been formerly too deeply lodged for germination.”

I make no remarks on the subject, nor on the doctrine, now

exploded, of equivocal generation: the mind becomes hampered when it dwells upon inquiries so deeply involved in mystery; but it may afford matter for reflection to the inquiring mind to view what has been said above, in connexion with the following "*botanical question*," which is stated in the *Register of Arts* of 1828.

611. "*Are all plants the result of the germination of a seed on virgin earth and vegetable mould? It is undoubtedly a very remarkable phenomenon, that the earth, when dug to the depth of eight or ten feet or more, produces all sorts of plants, provided it is advantageously exposed to the sun; but what is more extraordinary is, that this new vegetation frequently affords plants of kinds which have never been remarked in this country. It is natural to ask whence came these plants? Can it be admitted that the seeds of these plants were contained in the several kinds of earths? But could all these seeds, which had been perhaps above three thousand years under ground, without having ever been exposed to the action of the sun, have preserved the power of regenerating? If we strew ashes on high and arid heaths, we shall see some time afterwards clover and vetches growing there, though those two plants had never been seen in those places. Shall we believe that the seed of the clover and vetches was in the ground, and only waited for a stimulus to generate? How did it come there? We know that high and arid heaths never produce clover; it cannot, therefore, be considered as proceeding from a plant which formerly grew there. But even should we admit the possibility that these kinds of earths may contain clover-seed, this opinion cannot be maintained in some part of East Friesland, where wild clover is made to grow by strewing pearl ashes on peat marshes.*"

I shall add only a few words on this important question. If all plants, when chemically acted upon, yield oxygen, hydrogen, and carbon, why should it be thought impossible that the elements of these substances might, by the energy of the great natural agents, be so arranged as to become favourable to the developement of a newly organized being; and in what way could the conjecture impugn or compromise the truth of the law which ordains that each plant should contain its seed within itself? If the metal *potassium* produce clover on peat marshes, what must be the natural inference? Can *potassium* be an *oxide of hydrogen*, or does it stimulate germs, latent in inert peat?

612. *Period of germination*.—This is not, by any means, the same in all seeds; and it may be very difficult to ascertain with precision the exact time that is required for the developement of the

radicle and plantlet. Adanson's table, extracted from Keith's work, will, however, prove of some utility to the gardener. It is as follows:—

	Days.		Days.
Wheat, millet-seed . . . . .	1	Purslain . . . . .	9
Spinage, beans, mustard . . . . .	3	Cabbage . . . . .	10
Lettuce, anise-seed . . . . .	4	Hyssop . . . . .	30
Melon, cucumber, cress-seed . . . . .	5	Parsley . . . . .	40 or 50
Radish, beet-root . . . . .	6		Years.
Barley . . . . .	7	Almond, chesnut, peach . . . . .	1
Orache . . . . .	8	Rose, hawthorn, filbert . . . . .	2

613. *Formation of Seed-Beds.*—In the preceding sections on the cultivation of esculent vegetables, particular directions have already been given for the preparation and management of seed-beds, applicable to the raising of the various species that have there been treated of; but there are general directions for the forming of seed-beds which still remain to be noticed.

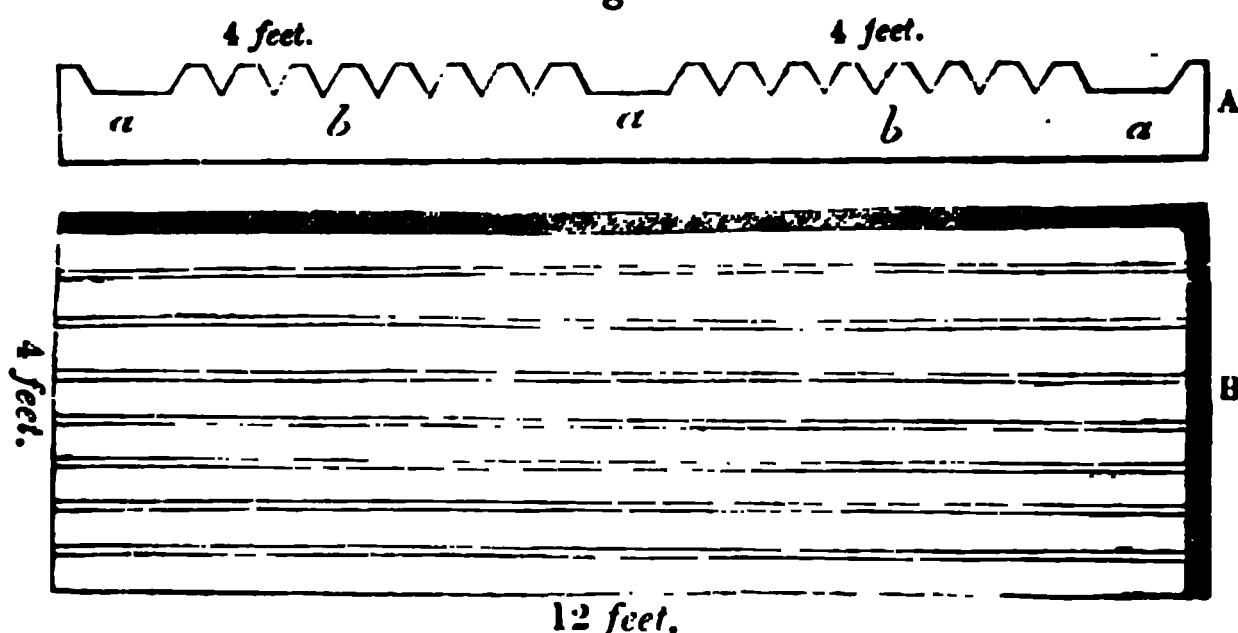
A seed-bed should be of such dimensions as to enable the gardener to have command of every part of it, without being obliged to trample on the soil after it has been sown. Hence, it can rarely admit of being more than four feet wide; and to form a handsome bed in the open area of the garden, the length ought to be at least three times that of the breadth: in the borders, a square form is admissible. Having carefully pulverized the ground, by digging, chopping, and raking—all which operations imply a dryish state of the soil—measure off the dimensions of the bed, and strain a line tight on each of the sides. Cut along the line with the edge of the spade, holding it in a somewhat slanting direction towards the bed, in order to form the edge broader at the bottom than at the surface, and thus to prevent the crumbling of the earth. If two or three beds are to be made at the same time, all the edges should be cut in the same way, and the alleys between them made a foot wide at the bottom, fifteen inches wide at the top, and three inches deep. The earth out of the alleys is to be thrown upon the beds, and then the surfaces of the latter are to be made as smooth as possible.

614. *Sowing the Seed.*—There are two methods of sowing: the one most commonly in use is that which is termed *broad-cast* sowing; it is the method of indolence, and is adopted because it is performed with the least apparent trouble; but the fact is, that in every subsequent operation, it is productive of great inconvenience and loss of time: to say nothing of the number of plants destroyed by treading over the bed.

*Drill Culture* is the method which I invariably practise, and earnestly recommend; it is that of neatness and precision in the first

instance, and it facilitates every future operation. Let *a, a, a,* (Fig. 31, A,) represent the section of three alleys, formed three inches deep, between two beds, *b, b,* each four feet wide. The fourteen drills in the figure are supposed to be six inches apart, and the two outermost to be drawn at the same distances from the edges of the beds.

Fig. 31.



These drills are made by straining the line very tight the whole length of the beds, and drawing the drills with the point or angle of the hoc, its blade resting against the line. The drills may be made from half an inch to two inches deep, according to the size and nature of the seed to be sown. Most people do no more than this; but as I am an advocate for making the drills of an equal depth throughout, I recommend that a round, smooth pole, an inch or less in diameter, be laid along each drill—particularly if the soil be of a friable texture—and gently pressed into it, so as to make the bottom smooth and level. The whole of the drills being thus prepared, the bed or beds will exhibit an appearance somewhat resembling that in the figure at B, (Fig. 31,) which represents a bed twelve feet long and four feet wide, containing seven drills. In these drills the seeds are to be sprinkled as regularly as possible; or if *broad-cast* sowing be determined upon, it can still be practised, and in the best possible manner; because almost all the seeds will fall into the drills, or be brought into them by the subsequent raking. If the seeds be very small and delicate, it will be proper to sift earth over them so as to fill the drills; and then the surface of the bed is to be made very smooth with the back of the rake. If it be sown broad-cast, the bed must be first well raked with the teeth of the rake, and finished off with the back.

Sometimes it will be needful to press the earth firmly upon the seeds; and gardeners are in the habit of treading them in by walking, with the feet placed close together, along the drills. By this

method the seeds are buried unequally, the ground is trodden into holes, and the pressure is greater in one part than in another. Wherever pressure is required, it will, I think, suffice to beat the surface steadily with the back of the spade; after which, the edges of the bed are to be cut, the bottoms of the alleys made firm and even, and then covered to the depth of an inch with sifted coal-ashes.

## 2. PROPAGATION BY RUNNERS, SUCKERS, AND LAYERS.

615. *By Runners*.—These are young shoots that issue from the collar or summit of the root of herbaceous plants. The collar is that part of the plant which forms the junction of the stem and root: it is thus described by Keith. “At the junction, which I have denominated the *collar*, there is generally to be observed a sort of irregular and circular protuberance, similar to that which is occasioned by the operation of grafting. This is owing, first, to its being the point of the insertion of the seed-leaves; secondly, to its being the point in which the divisions of the roots often originate, causing a deflection of the longitudinal fibres; and, lastly, by the different degrees of augmentation which take place in the root and stem, the latter augmenting more than the former, and consequently occasioning a bulge.”—(Vol. II. 253.)

The strawberry plant produces abundance of runners, and affords a good example of those herbs which produce creeping shoots, and knots of young rooted plants in the course of a summer. All that is requisite in propagating by runners, is to permit the young plants on the shoots to be well rooted before they are separated from the old stock. Strawberries may be moved at almost any time; but the months of September and March are the most favourable for the transplanting of runners in general.

616. *By Suckers*.—“These are merely runners under ground; some run to a considerable distance, as the acacia, narrow-leaved elm, sea lyme-grass, alkakengi, &c.; others are more limited in their migrations, as the lilac, syringa, Jerusalem artichoke, saponaria, &c. All that is necessary is to dig them up, cut off each plantlet with a portion of root, after which, its top may be reduced, by cutting off from one-fourth to one-half of the shoot, in order to fit it to the curtailed root; and it may then be planted either in the nursery department, or, if a strong plant, where it is finally to remain.”—(*Encyc. of Gard.* 1992.)

“Many plants,” Keith observes, “protrude annually from the collar a number of young shoots, encircling the principal stem, and

depriving it of a portion of its nourishment, as in the case of most fruit-trees. Others send out a horizontal root, from which there at last issues a bud that ascends above the soil, and is converted into a little stem. Others send out a horizontal shoot from the collar, or a shoot that ultimately bends down by its own weight till it reaches the ground, in which it strikes root, and again sends up a stem"—as in the currant, laurel, and laurustinus. This latter species of layer resembles the runner, "from which, however, it is distinguished in that it never detaches itself spontaneously from the parent plant. But if artificially detached, together with a portion of the root, or a slice of the collar adhering to it, it will now bear transplanting, and will constitute a distinct plant."

617. *By Layers*.—Layers may be described, in general terms, as young branches, or twigs of trees and shrubs, or corresponding lateral shoots of perennial herbaceous plants, which, being bent down to the ground, and inserted therein with certain needful precautions, protrude, first, a system of roots, by the agency of descending fluids and fibrous masses from the buds, and, finally, an entire new stem. After a certain time the layer may be separated from the parent stock, and transferred, according to its strength, either into a nursery bed, or to the place of its final destination. There are several methods of performing the operation of layering, and many important concomitants to be attended to. The following scientific observations are selected from the *Encyclopædia of Gardening*:—

618. *Season for layering*.—For trees and shrubs the season is usually the one which precedes the ascent of the sap, that is, during the months of February and March; or the operation is deferred until late in June or early in July, when the sap is fully risen. The latter period is most suitable for layering the *dianthus* or pink tribe.

619. *Operation of layering*.—"The shoot, or extremity of the shoot, intended to become a new plant, is half separated from the parent plant, at a few inches distant from its extremity; and while this permits the ascent of the sap at the season of rising, the remaining half of the stem being cut through and separated, forms a dam or sluice to the descending sap, which, thus interrupted in its progress, exudes at the wound in the form of a granulous protuberance, which throws out new roots. If the cut or notch does not penetrate at least half way through, some sorts of trees will not form a nucleus the first season; on the other hand, if the notch be cut nearly through the shoot, a sufficiency of alburnum or soft wood is not left for the ascent of the sap, and the shoot dies. In delicate sorts it is not sufficient to cut a notch merely, because in that case the descending sap, instead of throwing out granulated matter in the

upper side of the wound, would descend by the entire side of the shoot; therefore, besides a notch formed by cutting out a portion of bark and wood, the notched side is slit up at least one inch, separating it by a bit of twig, or a small splinter of stone or potsherd."—(*Enc.* 1994.)

620. *In layering with precision*, so as to avoid cutting and mangling, "it should be remembered, that the use of the notch is to prevent the heel or part intended to throw out granulous matter from being bruised, which it generally is, by the common practice of performing this operation by one cut sloping upwards; and that the use of the slit is to render it more difficult for the descending sap to return from the extremity of the heel. In conformity with this idea, Knight recommends taking up the shoot after it has grown some time, and cutting off a ring of bark below the notch and slit, so as to hinder the return of the sap, and thereby force the shoot to employ it in forming roots."—(*Hort. Trans.* Vol. I. 256.) "In burying an entire shoot, with a view to induce shoots to rise from every bud, notches alone are sufficient without either slitting or ringing. The use of the splinter of wood, or bit of tile or potsherd, is partly to prevent the union of the parts when the bent position of the shoot is not sufficient, and partly, and in some cases principally, to act as a stimulus. On what principle it acts as a stimulus has not, we think, been yet determined\*, but its effects have long been very well known to gardeners."—(*Idem*, 1995.)

In layering woody plants which are brittle and liable to break off, try the following method. Thrust a sharp pointed, narrow blade through the middle of the branch below a joint or bud,—then carry the edge upwards to, and through the first joint, and half way up the internode between it and the next bud or joint above it. At this point below, withdraw the knife, after having pressed in a piece of potsherd to keep the cut surfaces quite apart. Thus there will be a slit, perhaps an inch and a-half long, and a wedge in it, which will act the part of a notch. Layers so prepared are little liable to break off, and are as likely to protrude roots below the buds, as those which are prepared by the common notching and slitting.

\* If the inserted piece acts as a stimulus at all, the only way of accounting, philosophically, for such action, appears to me to be this. Fragments of tiles, stones, &c., accumulate moisture round about them; the accumulation of moisture implies the agency of attraction, and this moisture or aqueous fluid, thus attracted, is itself a decomposable fluid. Being in juxta-position with the vessels of the layer, it will tend also to induce lateral attraction between the vegetable juices and its own components; and this attraction—as a necessary consequence—will induce an increased action in the fluids of the layer, which may be termed *irritation*, a *stimulus*, or what else you please, whereby to express the same thing.

Mr. Marnock, I believe, suggested a process like the above for the layering of roses.

621. *Preparation of the Soil.*—"In layering trees in the open garden, whatever mode be adopted, the ground round each plant intended for laying must be dug for the reception of the layers; then making the excavations in the earth, lay down all the shoots or branches properly situated for this purpose, pegging each down with a peg or hooked stick: laying also all the proper young shoots on each branch or main shoot, fixing each layer from about three or four to six inches deep, according as they admit, and moulding them in at that depth, leaving the tops of every layer out of the ground from about two or three to five or six inches, according to their length, though some shorten their tops down to one or two eyes. Observe also to raise the top of each layer somewhat upright, especially tongue or slit layers, in order to keep the slit open. As the layering is completed, level in all the mould finally and equally in every part close about the layer, leaving an even, smooth surface, presenting only the tops of each layer in the circumference of a circle, and the stems or stools in the centre."—(*Idem*, 2001.)

In the annexed figure (32), Nos. 1 and 2 show the notches in two layers. No. 3 exhibits a detached portion of a layer, showing the position of the notch, slit, and emerging roots. No. 4 represents one of the pegs.

Fig. 32.



622. *Success in layering may be accelerated by a variety of operations.*

(1st.) *By piercing.*—"This is performed with an awl, nail, or pen-knife, thrust through two or three times in opposite directions at a *joint*; from which wounds, first, granulated matter oozes, and finally, fibres are emitted."

(2nd.) *By ringing*, which is cutting off a small ring of bark and part of the wood, by which, the return of the sap being impeded, it is, as it were, compelled to form roots. Care must be taken, however, that the ring does penetrate far into the wood,

otherwise the sap will be prevented from ascending in the first instance, and the shoot killed. “*Ring*ing is an excellent method for making layers of hard-wooded plants strike root with greater certainty, and in a smaller space of time than is attained by any other way. The accumulated vegetable matter in the callus, which is formed on the upper edge of the ring, when brought into contact with the soil, or any material calculated to excite vegetation, readily breaks into fibres and roots.”—(*Hort. Trans.* IV. 558.)

(3rd.) *By Wiring*.—“This is performed by twisting a piece of wire round the shoot at a joint, and pricking it at the same time with an awl on both sides of the wire. It is evident that all these methods depend on the same general principle, that of permitting the ascent of the sap through the wood, but checking its descent by cutting off, or closing the vessels of the bark.”—(*Idem*, 1997, et seq.)

623. *The operation of ringing* may be performed with an instrument called the ringing shears, that makes a double incision round the bark of the shoot. It may also be effected by a double-bladed penknife, both the blades being parallel one to the other, and open at once, consequently producing a double ring when they are passed round the shoot, of from one-eighth to one-sixth of an inch in breadth. The ring of loosened bark is then to be detached from the alburnum. A shoot so ringed may be passed through the hold of a flower-pot, and then, being surrounded with soil and kept moist, the shoot will very frequently emit roots, and may finally be detached from the parent stock by cutting it off close under the bottom of the pot.

I conceive that this method may be advantageously adopted for propagating apple-trees, particularly on espaliers, the upper shoots of which can be readily operated upon; and the situation is well adapted to the purpose, as the pot can be easily secured in an upright position. If the detached ring be very narrow, that is, of one-twelfth or one-sixteenth of an inch, the growth of the shoot, as I have witnessed, will be very luxuriant, and the wound will heal by granulations, forming an enlarged callus or broad ring of wood and bark around the shoot, but emitting no roots; therefore, to ensure success, the detached ring must be much broader: and, in that case, it may be prudent not to take off the whole of the bark, but to leave from one-eighth to one-fourth of its circumference upon the stem.

624. *Removing the layers*.—“Though layers of trees completed early in spring, and of herbaceous plants after the season of their flowering, are generally fit to remove from the parent plant by the end of the succeeding autumn, yet many sorts of American trees

require two years to complete their roots. On the other hand, some sorts of roses and deciduous shrubs, if their present year's wood be laid down when about half-grown, or about the middle of August, will produce roots and be fit to separate the succeeding autumn."—(*Idem*, 2006.)

### 3. BY SLIPS AND CUTTINGS.

625. *By slips*, are to be understood, either those shoots that spring from the collar, or upper part of the roots of herbaceous plants, as in *auriculas*, and most subjects of the genus *primula*, to which portions of roots are attached; or those little branches of under shrubs, sweet, and aromatic herbs, as basil, marjoram, savory, thyme, rue, &c., which, when the lower part of the wood begins to ripen, as it does in the second year's growth, are to be slipped or pulled off downwards from the parent plants. This mode of detaching the slip brings off a portion of the bark of the principal stem; and "the ragged parts and edges of this claw, or rough section, are then to be smoothed with a sharp knife, and the slip planted in suitable soil, and shaded till it strikes root, or appears to have recovered from the effects of amputation." Slips may be taken in the spring or autumn; the month of March, however, is to be preferred, as the fluids are then approaching to their greatest state of activity.

626. *Cuttings* are portions of shrubs and trees which are cut off with the pruning knife. They are selected chiefly from the shoots of the last year's growth, to which a small piece of the wood of the preceding year is attached, as a *talus* or heel. The *Encyclopædia of Gardening* treats of this method of propagation in a manner so consistently philosophical, that I cannot refrain from copying the article on "Cuttings," nearly at full length, marking those passages in italics which call for particular notice. It may be previously remarked, that cuttings should not be planted very deep; it will in general be sufficient to place three or four buds under ground; gooseberries and currants will strike at any depth; some apples will strike freely if merely thrust into the soil, others with difficulty, unless covered by a hand-glass. Hard-wooded plants in general do not strike freely; and some of them require a uniform stillness, moisture, and moderate degree of warmth. The protection of a hand-glass, and a slight bottom heat, greatly accelerate the protrusion of roots; and if the cuttings are in pots, they may be forwarded by being covered with a bell-glass, and then placed in a frame under a glass light.

627. *Choice of Cuttings*.—"Those branches of trees and shrubs

which are thrown out nearest the ground, and especially such as *recline*, or nearly so, *on the earth's surface*, have always the most tendency to produce roots. Cuttings then, are to be chosen from the side shoots of plants, rather than from their summits or main stems; and the strength and health of side shoots being equal, those nearest the ground should be preferred.

“The *proper time* for taking cuttings from the mother plant is when *the sap is in full motion*, in order that, in returning by the bark, it may form a callus, or protruding ring of granular substance, between the bark and wood, whence the roots proceed. As this *callus*, or ring of spongy matter, *is best formed in ripened wood*, the cutting, when taken from the mother plant, should contain a part of the former year's, or in plants which grow twice a year, of the wood of the former growth; or in plants which are continually growing, as most evergreen exotics, such wood as has begun to ripen, or assume a brownish colour. *This is the true principle of the choice of cuttings as to time*; but there are many sorts of trees, as willow, elder, &c., the cuttings of which will grow almost at any season, and even if removed from the plant in winter, when the sap is comparatively at rest. Cuttings from *herbaceous plants* are chiefly chosen from the low growths, which do not indicate a tendency to blossom; but they will also succeed in many cases, when taken from the flower stems; and some rare sorts of florists' and border flowers, as the dahlia, rocket, cardinal-flower, scarlet lychnis, wall-flower, &c., are so propagated.”—(*Encyclopædia*, No. 2064.)

628. *Preparation of the cutting*.—“This depends on, or is guided by this principle, that *the power of protruding buds or roots resides chiefly*, and in most cases entirely, at what are called *joints*, or at those parts *where leaves or buds* already exist. Hence it is that *cuttings ought always to be cut across*, with the smoothest and soundest section possible, *at an eye or joint*. And as buds are in a more advanced state in wood somewhat ripened or fully formed, than in a state of formation, this section ought to be made in the wood of the growth of the preceding season; or, as it were, in the point between the two growths. It is true, that there are many sorts of cuttings which not only throw out roots from the ring of granulated matter, but also from the sides of every part of the stem inserted in the soil, whether old and large, or young and small, as willows, currants, vines, &c.; but all plants which are difficult to root, as heaths, camellias, and orange-trees, will be found in the first instance, and for several years after propagation, to throw out roots, only from the ring of herbaceous matter above mentioned; and to facilitate the formation of this ring by properly preparing the

cuttings of even willows and currants, must be an obvious advantage. It is a common practice to cut off the whole or part of the leaves of cuttings, which is always attended with bad effect in *evergreens*, in which *the leaves* may be said to *supply nourishment* to the cutting till it can sustain itself. This is very obvious in the case of striking from buds, which, *without a leaf attached, speedily rot and die*. Leaves alone, as in *Bryophyllum calycinum*, will even strike root and form plants in some instances; and the same, as Professor Thouin observes, may be stated of certain flowers and fruits."—(*Idem*, 2065.)

629. *By ringing, cuttings which are difficult to strike may be rendered more tractable; "if a ring be made on the shoot which is to furnish the cutting, a callus will be created,"* (see No. 622,) "which, if inserted in the ground after the cutting is taken off, will freely emit roots. A ligature would perhaps operate in a similar manner, though not so efficiently; it should lightly encircle the shoot destined for a cutting, and the latter should *be taken off when an accumulation of sap has* apparently been produced. The amputation in the case of ligature, as well as in that of the ring, must be made below the circles, and the cutting must be so planted as to *have the callus covered with earth.*"—(*Hort. Trans.* iv. 558.)

630. "The insertion of the cuttings may seem an easy matter, and none but a practical cultivator would imagine that there could be any difference in the growth, between cuttings inserted in *the middle of a pot*, and those inserted *at its sides*. Yet such is actually the case; and some sorts of trees, as the orange, ceratonia, &c., if inserted in a mere mass of earth, will hardly, if at all, throw out roots, while, if they are inserted in sand, or in earth at the sides of the pots, so as to touch the pot in their whole length, they seldom fail of becoming rooted plants. Knight found the mulberry strike very well by cuttings when they were so inserted, and when their lower ends touched a stratum of gravel or broken pots; and Hawkins, (*Hort. Trans.* Vol. II. p. 12,) who had often tried to strike orange-trees, without success, at last heard of a method (long known to nurserymen, but which was re-discovered by Luscome) by which, at the first trial, eleven cuttings out of thirteen grew. 'The art is to place them to touch the bottom of the pot; they are then to be plunged in a bark or hot-bed, and kept moist.'"—(*Idem*, 2066-7.)

631. "*Piping is a mode of propagation by cuttings, and is adopted with herbaceous plants having jointed tubular stems, as the dianthus tribe; and several of the grasses and true arundos might be propagated in this manner. When the shoot has nearly done*

growing, which generally happens after the blossom has expanded, its extremity is to be separated at a part of the stem, where it is nearly, or at least somewhat indurated or ripened. This separation is effected by holding the root end between the finger and thumb of one hand, *below a pair of leaves*, and with the other, pulling the top part above the pair of leaves, so as to separate it from the root part of the stem at the socket formed by the axillæ of the leaves, leaving the stem to remain with a tubular or pipe-looking termination. These pipings, or separated parts, are inserted without any further preparation in finely-sifted earth, to the depth of the first joint or pipe, gently firmed with a small dibber, watered, a hand-glass placed over them, and their future management regulated on the same general principles as that of cuttings."—(*Idem*, 2069.)

## PART II.

### OPERATIONS PREPARATORY TO GRAFTING AND BUDDING.

632. These operations consist in preparing young trees, called *stocks*, for the reception of yearling shoots, known by the name of *Scions* or grafts, or *buds*, in order to perpetuate approved varieties, and to accelerate the fructification of fruit-bearing, or ornamental trees.

As most species of fruit-trees require different kinds of stocks, all of which may be raised from seed, though it does not necessarily follow that they must be so raised, it will be essential to notice the most approved methods of propagating stocks from seed. This part, therefore, will contain directions for raising seedling stocks for apples, pears, peaches, apricots, plums and cherries.

#### 1. RAISING THE STOCKS FOR APPLES.

633. *As apple-trees require to be grafted* upon stocks raised from apples or crabs, the seeds of these trees must be collected in the autumn, and then be either sown directly, or preserved in dry sand, in pots or boxes, till the succeeding March. I am inclined to think that the pips of any fine and favourite fruit, which it is desirable to raise, ought to be sown as soon as they are procured, in flower-pots, an inch deep, in a soil abounding with sand, say three-fourths of the whole; and thoroughly incorporated with one-fourth part of leaf-mould, or light vegetable earth. Each pot should then be

marked, and in the time of severe frosts, the pots may readily be removed to a convenient place of shelter, and in the early spring, be plunged up to the rims in the earth of some shady border.

634. The *seed-beds*, should be made pretty much in the same manner as those for vegetable seeds (613), but only three feet wide, and the soil ought to be a light, free-working, but moderately enriched, sandy loam; and it is said, that if strings of twine, or small cord, be dipped in a mixture composed of one pound of gas tar, a quarter of a pound of brown essential oil of coal-tar, and a quarter of a pound of grease, and then drawn and fixed across and about the newly-sown beds, they will prove a certain preservative against birds.—(See *Reg. of Arts*, 1828, p. 32.)

635. *Stocks from Seedling Apples and Crabs*.—"A preference," Knight observes, "has generally and justly been given to apple-stocks raised from the native kind, or crab, as being more hardy and durable than those produced from the apple. The offspring of some varieties of the crab, particularly of those introduced from Siberia, vegetate much earlier in the spring than the other trees of the same species; and thence the inexperienced planter will probably be led to suppose that such stocks would accelerate the vegetation of other varieties in the spring, and tend to produce an early maturity of the fruit in autumn. In this, however, he will be disappointed. The office of the stock is in every sense of the word subservient; and it acts only in obedience to the impulse it receives from the branches: the only qualities therefore, which are wanting to form a perfect stock, are vigour and hardiness."—(*Encyc. Gard.*, 4389.)

636. *Seeds, Sowing, and Culture*.—"In collecting the seeds to sow, it must be remembered, that the habits, as well as the diseases of plants, are often hereditary, and attention should be paid to the state of the tree from which the seeds are taken; it should be large, and of free growth, and rather in a growing state than one of maturity or decay. The crab-trees which stand in cultivated grounds, generally grow more freely, and attain a larger stature than those in the woods, and therefore appear to claim a preference. The seeds should be taken from the fruit before it is ground for vinegar, and sown in beds of good mould an inch deep. From these, the plants should be removed in the following autumn to the nursery, and planted in rows at three feet distance from each other, and eighteen inches between each plant."—(*Idem*, 4390.)

637. *General Directions*, as simple as they are perspicuous, are furnished by the *English Gardener*, Ch. 6, No. 205.—"The pips of crabs, apples, pears, and quinces, are obtained from the fruit; the three former in great abundance when cider, perry, or verjuice are

made; the last with some difficulty, on account of the comparative rareness of the fruit, but quince stocks are so easily obtained from cuttings or layers that this is not a matter of much consequence. The pips are, of course, collected in the fall of the year; and when collected, make them dry, put them immediately into fine dry earth or sand, and keep them safe from mice until the month of March.

“When that month comes, dig a piece of ground well and truly, make it rich; make it very fine, form it into beds three feet wide, draw drills across it at eight inches distance, make them from two to three inches deep, put in the seeds pretty thickly, cover them completely, tread the earth down upon them, and then smooth the surface. When the plants come up, thin them to about three inches apart, and keep the ground between them perfectly clean during the summer. Hoe frequently, but not *deep near the plants*; for we are speaking of *trees* here; and trees do not renew their roots quickly as a cabbage or a turnip does. These young trees should be kept, during the first summer, as *moist* as possible, without watering; and the way to keep them as moist as possible, is, to keep the ground perfectly clean, and to hoe it frequently.”

## 2. RAISING STOCKS FOR PEARS.

638. *Pears* are grafted or budded upon the common wild pear, with a view to *dwarfing*: and to bring them into early-bearing condition, they are grafted upon the quince and whitethorn. They also succeed upon the white beam (*Pyrus aria*), service (*Pyrus torminalis*), the medlar, and the apple.

639. *Propagation from seed*.—The seeds may be sown and the beds managed according to the directions given for the apple, and abundance of new varieties may thus be obtained. “Professor Van Mons, proprietor of the *Pepinière de la Fidélité*, at Brussels, has upwards of 800 approved sorts of new pears raised from seed by himself and M. Duquesne, of Mons, in the course of fifteen or sixteen years, and selected from probably 8,000 new seedling fruits. Van Mons observed to Neill that ‘he seldom failed in procuring valuable apples from the seed, for those which were not adapted to the garden as dessert fruit were probably suited for the orchard, and fit for baking, or cider-making. With pears the case was different, many proving so indifferent as to be unfit for any purpose.’”—(*Horticultural Tour*, &c., 309.) “Whenever a seedling indicates, by the blunt shape, thickness, and woolliness of its leaves, or by the softness of its bark and fulness of its buds, the promise of future good qualities, as a fruit-bearing tree, Van Mons takes a cutting from it, and places it

on a well-established stock; the value of its fruit is thus much sooner ascertained."—(*Idem*, 310.) "At Brussels, seedlings yield in four or or five years; in Britain, seldom before seven or ten years have elapsed. The fruit of the first year of bearing is always inferior to that of the second and third years. If a pear or an apple possess a white and heavy pulp, with juice of rather pungent acidity, it may be expected in the second, third, and subsequent years, greatly to improve in size and flavour. New varieties of pears, and indeed of all fruits, are more likely to be obtained from the seeds of new than of old sorts."—(*Idem*, 308, 309.)

### 3. RAISING STOCKS FOR PEACHES AND NECTARINES.

640. *The peach and nectarine* are occasionally propagated by budding them upon almond and peach stocks, but principally upon plum-stocks, as being the most hardy, durable, and prosperous. These stocks are raised from stones sown in drills in the autumn, and two inches deep. The soil, according to Miller, should be light and dry, and during winter the beds ought to be protected from frost, which is likely to destroy the seeds. The young trees may be planted out in nursery rows when one or two years old. The musclem plum, according to Abercrombie, furnishes the stock whereon the peach may be most successfully budded.

Mr. Knight, in his *Observations on the Method of producing new and early Fruits, and on some Varieties of the Peach\**, concludes, "I entertain little doubt that the peach-tree might, in successive generations, be so far hardened and naturalized to the climate of England and Ireland, as to succeed well as a standard in favourable situations. The peach does not, like many other species of fruit, much exercise the patience of the gardener, who raises it from the seed; for it may be always made to bear when three years old. I will not venture to decide whether it might not possibly produce fruit even at the end of a single year. In prosecuting such experiments, I would recommend the seedling peach-trees to be retained in pots, and buds from them only to be inserted in older trees; for their rapid and luxuriant growth is extremely troublesome on the wall, and pruning is death to them." He afterwards succeeded in producing blossom-buds the first year; the means used were, leaving on the laterals near the extremities of the shoots, and exposing the leaves as much as possible to the sun, in order to promote the growth and ripening of the wood."—(*Encyc. of Gard.*, No. 4492.)

\* *Horticultural Transactions*, Vol. I.

## 4. RAISING STOCKS FOR APRICOTS.

1. *Apricots* are usually budded upon stocks raised from the of apricots or plums. New varieties are raised from the stones former, as in the case of the peach; and for the moor-park, Knight recommends a stock raised from an apricot-stone. (See 12.) For the Brussels, Breda, and most other varieties, any stocks will do; though in all probability, the apricot-stock to be chosen.

2. *For the propagation of stone-fruit stocks, generally*—the *h Gardener* directs the stones to be taken from the fruit when ripe, “made perfectly dry in the sun, then packed in perfectly sand, and kept there until the month of November, when they must be sowed in just the same manner as described for the except that they ought not to be closer than an inch from each other in the drill, and should be covered to the depth of three inches, or perhaps, a little more. The plants will come up in the spring, and will attain a good height the first summer. They should be planted in the fall, first taking off the tap root, and shortening the roots. In the next month of April, they should be cut close to the ground, and suffered to send up only a single stalk for budding or budding upon. They should now be planted in rows at six feet apart, and at a foot apart in the row, in order to give them room for the operations of grafting and budding.”—(Chap. vi. 205.)

## 5. RAISING STOCKS FOR PLUMS.

3. *Plums are budded upon plum-stocks*, and to raise them, the of the muscle, St. Julian, and magnum-bonum plums, are preferred.

They are to be sowed as soon as they are gathered, or they may be preserved in sand until the spring, agreeably to the directions in the last paragraph. The seed-bed should be of the same dimensions as those for apricots, and the soil of a medium quality, of a mellow and loamy, than of a light and sandy texture. Stocks may also be raised in pots, by sowing one stone in a pot, or three in a large one, in moderately rich soil. They may be preserved under shelter during severe frosts, and will be ready to start earlier in the spring.

## 6. RAISING STOCKS FOR CHERRIES.

4. *The Stocks for Cherries are Cherries*.—They may be raised upon plum stocks, and the stones of any kind of cherries will do;

though it is thought that those of the wild cherry should be preferred. "Cherry-stones, whether for stocks or new varieties, are sown in light sandy earth in autumn; or are preserved in sand till spring, and then sowed. They will come up the same season, and should not be removed till the second autumn after sowing. They may then be planted out in rows three feet apart, and the plants one foot asunder in the row. The succeeding summer they will be fit to bud, if intended for dwarfs; but if for standards, they will require to stand one or more seasons, generally till four years old."—(*Encyclopædia*, 4881.)

### PART III.

#### PROPAGATION OF FOREST-TREES.

645. As so much importance has been attached to the department of the garden that is to be stocked with forest-trees, I shall conclude this section with a few directions for propagating the ash, the locust, or pseudo-acacia, and the live or evergreen oak.

*Cultivation of the Ash (Fraxinus excelsior.)*—This tree produces its seed in keys, and these become ripe in November. They are to be preserved in moist sand till the month of February, and may then be sown in beds three feet wide, in drills an inch deep.

*The Encyclopædia of Gardening* directs the sowing to be effected in what it styles the "bedding in" manner; and it observes that the ash will grow in soil of a medium quality, but that the bed should be well dug, and in an open situation. *Bedding in sowing* is thus described:—The ground must be previously digged or trenched, raked, and formed into beds three or four feet wide, with alleys between bed and bed; then with a rake or spade, trim the earth evenly from off the top of the bed into the alleys, from two or three inches deep for bulbous roots, and for seeds, one or two inches, according to what they are, and their size." The seeds being scattered moderately thin on the surface of the ground, "let the earth that was drawn off into the alley be spread evenly upon the bed again over the seeds, being careful that they are covered all equally of the above depth, and rake the surface smooth. This method is also practised in nurseries, for sowing such seeds as require great accuracy in covering, as the larch, pine, and fir tribes, and indeed for most other tree seeds."—(2091.)

In the operation of sowing these seeds, I decidedly give the preference to "drill sowing," as directed for sowing the pips of apples,

for the reasons before given. The beds are to be lightly and carefully hoed between the rows of seedlings, and kept perfectly clean by hand-weeding when the hoe will not pass; and this will apply to all seed-beds whatever.

646. *Cultivation of the locust, or pseudo-acacia, and the laburnum, as directed in the Encyclopædia of Gardening.*

*Gathering and keeping the Seeds.*—"These being collected, are to be dried thoroughly in an airy loft, and the pods being afterwards threshed or opened, the seeds may be preserved in bags or boxes till spring, or sent to any distance.

*Sowing.*—"The season for sowing is February; the soil should be light, deep, and sandy, and the seeds placed an inch apart, and covered three-quarters of an inch thick. This should be particularly attended to in the case of the laburnum, the seeds of which being generally sure growers, if they rise thick, they lose their leaves about midsummer, become mildewed, and die."

*Mr. Cobbett's directions for the Cultivation of the Locust.*—"When you have prepared the beds, in the manner described for the *ash*, take in the morning as much seed as you think you can conveniently sow before night; put it into a tub, or some vessel sufficient to hold the seed, with water five or six times as much in measure as the seed; then take water at full boil out of your copper or other boiling vessel, pour it upon the seed; give the seed a stir up amongst the water, cover over the top of the vessel close, and there let the seed remain for an hour or two. Then take off the cover of the vessel, and raise up some of the seed by a ladle, or some such thing, and look at your seed, some of which you will find swelled to nearly double their former size. Another hour, or perhaps less (and you ought to look frequently at them), will have made all the seeds swell, except a small part perhaps, and those will not grow at all. Then pour the seed, water and all, in a fine sieve, which will let the water through, and keep the seed back; have some dry sand ready, with a hole made in the middle of the heap, to put your seeds into, and then mix up the whole heap of sand with the seeds: about three gallons of sand to one gallon of seed.

"Your beds are already prepared, and now you scatter the seed over them along with the sand, in the manner described in the case of the *ash*. Do not sow too thickly; if you do, many of the plants will be destroyed by the others, and will be very weak, and not fit to plant out the first year at the least. If sowed thinly, and if the ground be good, and the beds kept clean, your plants will be four feet high by the month of October, quite fit to go into plantations out of the seed-bed. My plants are always sold from the seed-bed,

and a very large part of them are fit to go into plantations at once; but this cannot be the case if the plants be sowed thickly.

“ I have never sowed locusts till the month of April, or very late in March; because, by soaking, they are made to come up in the space of a fortnight, and they should not come up till the sharp frosts be all gone. But when seeds have been soaked in this manner, there is great care required to keep them from the sun and the wind; they should, therefore, be covered as quickly as possible after they have been scattered on the bed, and the earth that goes on them should be made very fine. The covering must not be more than an inch deep, and must be laid on very evenly, and with the greatest possible care, so that no openings may be left for the sun or wind to find access through. If the weather be dry, as it ought to be for the work of sowing, water the beds gently, with a fine-rose watering-pot, the second day after sowing; but not by any means while the earth is fresh at top, for if earth be freshly moved when you water, it runs together, and binds over the top, where it forms a shell, which is difficult for the heads of the plants to penetrate.

“ When a locust-tree is a foot and a-half or two feet high, it is quite fit to go into any plantation, even amongst other trees; for if cut down in the month of April, the year after planting, or even in May, it will soon overtop other trees; but if the plants be really too small to put out at once, they should be assorted with care, the stout ones in one lot, and the weak ones in another; and thus precisely after the manner of the ash, put into the nursery, the roots having first been properly pruned.”—(*Woodlands*, par. 384, 5, 6, and 388.)

In 1831, I made several experiments with the seeds of *Robinia*, *Pseudo-acacia*, and *Gleditschia triacanthos*, and the results lead me to doubt the safety of employing boiling-hot water. I immersed several portions in water at 125°, 140°, 150°, 170°, and 210°, also a few seeds in a cold, weak solution of chloruret of lime. Those soaked in the last fluid, never vegetated: the vital principle was extinct. (I have lately found *oxalic acid* a fatal application.) Of the seeds exposed to 210°, very few germinated; but all the others, those particularly in water at 140°, rose freely.

I tried unprepared seeds in the open ground, but the success was little, because the plants were, no doubt, bitten off, underground; but I was most fortunate with a number of robinia seeds which I sowed, without preparation, in a ‘thirty-two’ pot of very light soil, placing the pot in a melon pit, wherein the heat seldom was less than 60°. The pot was filled, and in transplanting subsequently, I lost very few of the seedlings.

647. *Cultivation of the Evergreen Oak (Quercus Ilex), and of the*

American live oak (*Q. phellos virens*, or *Q. Molucca* of Abercrombie). These trees can be raised from acorns only; their propagation is thus generally described by Abercrombie.

“The propagation of all the sorts of oak, is by sowing the acorns either as soon as ripe in November, or preserved in sand till February; and having prepared four-feet wide beds of light earth, sow the acorns either in drills two inches deep, and half a foot asunder, or by broad-cast, previously trimming two inches of earth off the surface into the alley (see 645); then scatter the acorns evenly in the bed, moderately thick; press them into the earth with the spade, and cover them with the earth two inches deep: they will come up in the spring; and when the plants are one or two years old, plant them out in rows, previously pruning their tap root, and side shoots; the rows two feet and a-half asunder, and let them be trained to single stems, cleared from side shoots, preserving the top shoots always entire to aspire in height.” — (*Dictionary—Quercus.*)

*The live oak*—Mr. Cobbett observes—of all the oaks, “is the one of the most value. It is evergreen, has smooth oblong leaves, of a deep green, upon the upper side, and whitish on the under side. This tree grows well in England, and ripens its seeds in England; there are several trees of it in the king’s gardens at Kew, and I have seen acorns upon them in a very perfect state.”—“Michaux tells us that it flourishes best near the sea, and is proof against all storms and blasts—that it is sought after with most destructive eagerness, and he considers its disappearance from the United States within fifty years as nearly certain.”—“It is a large and beautiful evergreen, not liable to be broken by winds, every twig being as tough as a bit of rope, never flinching at the frost and snow, and affording the completest of shelters to gardens and houses.”

“The acorns are sowed in the same manner as directed for the sowing of the acorns of the common oak; they attain the height of from five to seven inches the first summer, and then they ought to be removed into a nursery.

“The live oak ought to stand two years in the nursery, for it will not make much of a shoot the first year; and then it ought to be planted out where it is to stand; for if planted out at a greater age, it will certainly be exposed to the risk of not taking root until the top of the plant be injured.”—(*Woodlands*, par. 446, &c.)

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## SECTION II.

## PART I.

NATURAL HISTORY AND CULTIVATION OF ESCULENT  
VEGETABLES.

Subject 1. THE ONION:—*Allium Cepa*; *Asphodeleæ*. Class vi.  
Order i. *Hexandria Monogynia* of Linnæus.

648. The genus *Allium* comprises seven British species; its essential generic character is, “a flower inferior, or below the fruit, without a calyx. *Corolla*, of six oval petals. *Stamina*, awl shaped, flattened. *Stigma*, acute. *Seeds*, angular.”—(*English Flora*.)

*The common bulbous onion*, Loudon says, “is a biennial plant, supposed to be a native of Spain; though, as Neill observes, ‘neither the native country, nor the date of its introduction into this island are correctly known.’ It is distinguished from other alliaceous plants by its large fistular leaves, swelling stalk, coated bulbous root, and large globular head of flowers, which expand the second year in June and July.”

649. The *varieties* are numerous, but I select the five following:—

The “*Silver-skinned*; flat, middle-sized and shining; chiefly used for pickling.

“*True Portugal onion* of the fruiterers; large flatly globular, mild; it does not keep well.

“*Spanish*, Reading, white Portugal, Cambridge, Evesham, or sandy onion; large, flat, white tinged with green, mild.

“*Strasburgh*, Dutch or Flanders onion; oval, large and light-red, tinged with green, hardy, keeps well; of a strong flavour.

“*Underground* or *potatoe-onion*; multiplies itself by the formation of the young bulbs on the parent root, and produces an ample crop below the surface; ripens early, but does not keep beyond February; flavour strong.”—(*Encyclopædia*, p. 639.)

650. *Estimate of Sorts*.—The Strasburgh is to be chosen for the main crops, as being the best keeping onion, though the Spanish and Portugal kinds attain to great perfection, and yield large crops. The silver-skinned is to be preferred for pickling; and the potatoe-onion is planted either as a curiosity, or to produce a winter crop.

651. *Soil*.—All the varieties, Abercrombie says, “grow freely

in any common good garden soil, in an open situation ;” but I have observed that if onion seed be sown in March or April, and a very dry season, with acute, parching winds, set in soon afterwards, the young plants will not rise at all. I sowed twice, just before the drought which occurred in May 1829, set in, and did not obtain one plant till the rains of June moistened the soil ; consequently, not one of the onions produced a bulb ; but they remained green throughout the winter, and were taken up in February 1830, in a state fit to be used with salad herbs.

The following remarks and directions for the preparation of the soil, I conceive to be very judicious :—“ The onion, ‘ to attain a good size, requires rich mellow ground on a dry sub-soil. If the soil be poor or exhausted, recruit it with a compost of fresh loam and well-consumed dung, avoiding to use stable dung in a rank un-reduced state. Turn in the manure to a moderate depth, and in digging the ground let it be broken fine. Grow picklers in poor light ground to keep them small.’ The market gardeners at Hexham sow their onion-seed on the same ground for twenty or more years in succession, but annually manure the soil. After digging and levelling the ground, the manure, in a very rotten state, is spread upon it, the onion seed sown upon the manure, and covered with earth from the alleys, and the crops are abundant, and excellent in quality.”—(*Encyc. of Gard.*, 3815.)

I have recently practised the following method, from a hint which I received from a friend who had been an almost universal traveller. The ground is prepared as above described, with as much manure as can be well digged in ; it is then beat to a solid surface, with a turf-beater, small lines are scratched upon the beaten surface, and in these lines the onion seed is sprinkled very thinly, that is, to the extent of three seeds in an inch space ; the seeds are then covered by sifting a quarter of an inch of sand over the bed ; finally, the surface is flattened by patting it with the back of the spade. Onions, so treated, become really *surface bulbs*, they expand regularly, and rarely grow “ bottled,” and deformed.

652. *General Culture according to Abercrombie.*—“ All the varieties are raised annually from seed sown from about the 20th of February, to the end of March, for the main summer crops of keeping onions ; but not later than the first fortnight of April, unless to produce small onions for pickling ; and in autumn, some time in August, for smaller crops to stand till the spring, for green young onions.

“ Choose an open plat of the best, rich, light ground ; to which, if some good rotten dung is added, and dug in one spade deep, it will be

of particular advantage. Then, while the ground is fresh dug, before it is rendered too dry, or wet, sow the seed, either broad-cast over the surface, in one continued plat, or divide the ground into four or five-feet wide beds, treading out foot-wide alleys between; observing, in either method, to sow the seed evenly with a spreading cast; then directly, if the ground be light and dry, tread the surface regularly, to settle it evenly, and the seeds equally where they fall, especially that sown in one continued plat, in order that when you stand to rake in the seeds, it may not sink into holes; and directly rake the ground regularly with an even hand, trimming off all stones; and for that sown in beds, you may previously, before you rake in the seeds, lightly pare the alleys with a spade an inch or two deep, casting the earth on the beds over the seeds; then rake, and clear the beds.

“The plants will come up in about three weeks. Keep them very clean from weeds, either by hand-weeding, or small hoeing, and in May and June, when advanced about four or five inches in growth, they must be thinned either by drawing as young onions, or by small hoeing with a two-inch hoe, in dry weather, cutting up all weeds, and thin out the plants to four or five inches distance, that they may have sufficient room to bulb.”—(*Pocket Dictionary*—‘*Allium*.’)

653. *Onions should be sown in drills* about an inch and a-half deep, the drills from eight inches to one foot asunder, according to the variety to be sown. They can then be kept clean by the Dutch hoe, passed very lightly between the rows. When onions are to be drawn young, two ounces of seed will be sufficient for a bed four feet by twenty-four; but when they are to remain for bulbing, one ounce may be allowed for a bed, five feet wide, by twenty-five feet long. Young onions will succeed if transplanted; and therefore in thinning the beds as before directed, if it be intended to form others, some well rooted young plants may be set out in rows six inches apart every way; but they will require occasional waterings if the weather be dry.

“M’Phael directs the seed-beds to be rolled after the seed is sown and the surface raked; that is, if it be not in too wet a state.

654. *Transplanting young Bulbs*.—“Knight observes that every bulbous-rooted plant, and indeed every plant that lives longer than one year, generates in one season the sap or vegetable blood which composes the leaves and roots of the succeeding spring. ‘This reserved sap, is deposited in, and composes, in a great measure, the bulb; and the quantity accumulated, as well as the period required for its accumulation, varies greatly in the same species of plant,

er more or less favourable circumstances. Thus the onion, in south of Europe, acquires a much larger size during the long and m summers of Spain and Portugal, in a single season, than in colder climates of England; but under the following mode of ure, which I have long practised, two summers in England produce nearly the effect of one in Spain or Portugal, and the onion assumes nearly the form and size of those thence imported. Seeds of the Spanish or Portugal onion are sown at the usual period in the ing, very thickly, and in poor soil, generally under the shade of a t-tree, and in such situations, the bulbs in the autumn are rarely nd much to exceed the size of a large pea. These are then taken n the ground, and preserved till the succeeding spring, when they are planted at equal distances from each other, and they afford plants which differ from those raised immediately from seed, only from possessing much greater strength and vigour, owing to the quantity previously generated sap being much greater in the bulb than in seed. The bulbs thus raised, often exceed considerably five inches in diameter, and being more mature, they are with more tainty preserved in a state of perfect soundness, through the winter, than those raised from seed in a single season.'"—(*Encyclopedia of Gardening*, 3818.)

There is considerable difficulty to raise these little bulbs, in some parts: I succeeded perfectly in 1836, and in the following year planted them in February, side by side, with Portugal, and Reading (Spanish) onions, raised by seeds sown as before directed. They all became rivals in growth, and produced an equable crop of large bulbs; but I was sorry to perceive that the transplanted bulbs—such as they were—tended to decay, and become mouldy in October. Others have found, I hear, the same result.

655. *On the subject of preserving and replanting*, the *English Gardener* directs to "take these diminutive onions, put them in a bag, and hang them up in a dry place till spring, taking the biggest for pickles. As soon as the frost is gone, and the ground dry, plant these onions in good and fine ground, in rows a foot apart. Make, not drills, but little marks along the ground, and put the onions at six or eight inches apart. Do not cover them with the earth; but just press them down upon the mark with your thumb and fore-finger. The ground ought to be trodden, and slightly pressed again before you make the marks, for no earth should rise about the plants. Proceed after this as with sowed onions; only observe that, if any should be running up to seed, you must twist round the neck as soon as you perceive it. But observe this, the shorter the time that these onions have been in the ground the

year before, the less likely will they be to run to seed."—(*Onion*, par. 166.)

*Summer Onions.*—Very fair bulbs may be procured in June, July, or August, according to the season and weather, by making a bed of fine deep earth, very rich with manure, and beating the surface. This is to be done early in February, and bulbs of the previous year, about one inch in diameter, are to be pressed about half an inch into the solid ground, at equal distances of six or eight inches. The leaves will grow rapidly, if care be taken to sprinkle soot and lime among them to keep worms away. When the flower-heads become visible, pinch them off; the sap being thus diverted, will pass down, and form new bulbs, which will enlarge freely:—two, three, or four medium-sized onions will thus be obtained at a season when they may be very desirable.

656. *Taking the Crop.*—It is often recommended to twist the stems of onions, or to bend them down, when they begin to turn yellow. The practice, however, is, I think, of very doubtful utility: for, if the leaves be of any use at all, if they still retain any activity, the result of bending must be an interruption of the descending juices; and if they have already begun to wither, but little effect of any kind can be produced. Warre observes—"In Portugal, when the onions are ripe, they are drawn up out of the ground, and a twist is given to the top, so as to bend it down. They are then left on the ground to season, before they are housed, then immediately platted with dry straw into ropes or strings of twenty-five each, and hung up to dry; they are not permitted to sweat in a heap."—(*Encyclopædia*, 3825.)

657. *To save the Seed.*—Select some of the finest bulbs in November or February. Prepare a narrow bed of rich, light earth; draw one or more very shallow drills, or make marks by the line placed lengthways on the bed, twelve inches apart. With another line placed across the bed, intersect the other drills at points twelve inches asunder. Thus the bed will be formed into foot-wide squares. At the angles of each of these squares, press in the bulbs to the half of their depth, and as they shoot up into stalk, place a trellis-rail along each row, or a double one along a single row, so as to support the stems. These will rise to the height of two or three feet, producing large globular heads of seed. When they are ripe, cut off the heads one by one, and drop them into a paper bag, to prevent the loss of seed: then expose the heads on a cloth, or sheet of paper, to the sun's rays, till they become perfectly ripe. Rub out the seeds, and preserve them in a bag or box.

658. *Culture of the Potatoe-Onion.*—Maher, of Arundel Castle,

says, "Having prepared the ground, and formed it into beds four feet wide, I draw lines the whole length, three to each bed, and with the end of the rake handle, make a mark (not a drill) on the surface; on this mark I place the onions, ten inches apart; I then cover them with leaf-mould, rotten dung, or any other light compost, just so that the crowns appear covered. Nothing more is necessary to be done until they shoot up their tops; then, on a dry day, they are earthed up, like potatoes, and kept free from weeds until they are taken up. In the west of England, where this kind of onion is much cultivated, I understand that it is the practice to plant on the shortest day, and take up on the longest. The smallest onions used for planting, swell and become very fine and large, as well as yield off-sets; the middle-sized and larger bulbs produce greater clusters."—(*Hort. Trans.* III. 305.)

Experience has taught me, that potatoe-onions, if planted as directed by Maher—even so late as the middle of February—will, with common care to keep the ground free from weeds, produce a fine crop of fair-sized bulbs in clusters, about, or soon after, mid-summer.

"*Wedgewood* does not earth up, and finds his bulbs acquire a much larger size than when that practice is adopted."—(*Idem*, III. 108.) "The fact is that surface-bulbs, as the onion, turnip, &c., are always prevented from attaining their full size by that operation, whatever they may gain in other respects."—(*Encyc. of Gard.*, No. 1829.)

The foregoing remark does not appear to me to apply to the subject under consideration: for if this variety be an *underground-bulb*, as it is distinctly stated to be, it can neither with propriety be styled, nor treated, as a *surface-bulb*. I grew one crop in 1831, but saw no necessity of earthing-up: the bulbs protruded their necks only.

## Subject 2. THE LEEK:—*Allium Porrum*.

659. The *Leek* is a biennial, it produces an oblong, tunicated root; cauline, or stem-growing, broad, flat leaves, rising from, and seated on the stem; and spreading out in opposite directions; and a flower-stalk terminated by a large spherical umbel. "It is a native of Switzerland, and was introduced in 1562. The leek is mentioned by Tusser; but was, no doubt, known in this country long before his time." Leeks formerly constituted an ingredient in the dish called porridge, which name, some suppose to have been derived from the Latin word *porrum*.

*There are three varieties:—*

The *narrow-leaved*, or Flanders leek; the *broad-leaved*, or London leek; and the *Scotch*, or Musselburgh leek; all of these are raised from seed, one ounce of which will sow a bed of four feet wide, by eight feet in length.

660. *Soil, Situation, and Culture.*—Leeks, like the onion, require an open situation, and that the ground be good, light, rich, and upon a dry sub-soil. The first sowing may be made about the middle of February; but the main crop ought to be sowed in the middle of March, or early in April at the latest. Sow the seed in drills, six or eight inches apart, and when the plants come up, keep them free from weeds, and thin them out to three inches, plant from plant. As the leek benefits much by transplantation, beds should be prepared four feet wide, about the middle of July, to receive three rows of the young leeks, which are to be set out in very deep drills. Then raise a sufficient number of the stoutest plants, trim off the long fibres from the roots; set them with a dibber nine inches asunder, and nearly as deep as the origin of the leaves. Press the soil to the fibres with the dibber, but leave the upper part of the hole open, so that the leek may stand as in a case of earth. “Give water if the weather be dry. Thin out those remaining in the seed-bed, to six or eight inches distance, and keep the whole clear from weeds. In hoeing, loosen the ground about the plants, to promote their free vigorous growth.” Some plants will attain a mature useful size in September, October, and November; and others will succeed, and continue in perfection during the whole winter and the following spring. When frost is expected, a part may be taken up, and laid in sand. The latest sown crops will probably continue till May.

661. To save leek-seed, Abercrombie directs, “About February or March to plant out a quantity of the largest old leeks, in a warm sunny situation, in rows two feet asunder, by one in the row, giving them water at planting; they will shoot up seed-stalks in May, and ripen seed in September.” They will ‘seed’ well without removal.

### Subject 3. CHIVES, OR CIVES:—*Allium Schoenoprasum*.

662. “The *Chive* is a native of Britain, found in Oxfordshire, Berwickshire, and Argyleshire; *flowers*, of an elegant purplish rose-colour; *leaves*, cylindrical, somewhat tapering at the point; root, perennial, composed of small, slender bulbs, pale, forming dense tufts.”—(*English Flora*.)

The leaves are used early in the spring for salads: they are

generally cut off close to the surface, but sometimes, the whole of the plant, with its roots, is made use of as a substitute for young onions.

*Cultivate*—by dividing the roots; the plant is very hardy, and will thrive in almost any soil and situation. Plant the slips in spring, or autumn, in patches, six or eight inches apart: they will rapidly form large bunches, which will last for three or four years.

Subject 4. GARLIC:—*Allium Sativum*.

663. Garlic is a hardy perennial, a native of the south of France. The root is a compound bulb, consisting of ten or twelve smaller parts, or bulbs, that are termed *cloves*. The leaves are long, flat, and narrow. It flowers in June and July, and has been cultivated in England since 1548.

664. *Culture*.—Garlic may be raised from seed, but is much more readily propagated by dividing the roots into separate cloves, or small bulbs, and planting them in drills. In February, March, or April, prepare a small bed of rich, light, and dry soil, not saturated with dung. Make the drills two inches deep, and nine inches asunder, press the bottom of each clove into the earth to the depth of another inch, and set the roots six inches apart; then draw the earth that came out of the drills over the bulbs; or, what is better, treat them in the way of tulips—that is, fill up the drills with fine sand, and then make the beds level with the back of the rake. Keep the plants free from weeds during the summer, till the leaves indicate, by their changing to a yellowish colour, that the roots have attained their full growth. Then take up the bulbs with a hand-fork; rub off the soil, expose them in a sunny situation for a few days, and, when perfectly dry, hang them up in a dry room for use.

Subject 5. THE SHALLOT, OR ESCHALOT:—*Allium Ascalonicum*.

665. *The Shallot*, as its name imports, is a native of Palestine, and more immediately of Ascalon or the adjacent parts. The roots are compound, like those of garlic; the leaves rise in clusters from the roots; the flower-stalk is cylindrical, naked, and supports a small globose umbel of flowers. The shallot is chiefly used to flavour beef-steaks; but it may sometimes be introduced into India pickle as a substitute for garlic.

666. *Cultivation*.—It is precisely the same as that of garlic, but autumnal planting in October and November is preferred. The

shallot is very subject to the attacks of a maggot; therefore, to preserve the roots from its depredation, Mr. Knight has suggested a mode of surface-planting, by which he has succeeded in growing very fine bulbs. It is thus described:—

“He places a rich soil beneath the roots, and raises the mould on each side to support them until they become firmly rooted. This mould is then removed by the hoe, and water from the rose of a watering-pot, and the bulbs, in consequence, are placed wholly out of the ground. The growth of these plants,” he adds, “now so closely resembled that of the common onion, as not to be readily distinguished from it, till the irregularity of form, resulting from the numerous germs within each bulb, became conspicuous. The forms of the bulbs, however, remained permanently different from all I had ever seen of the same species, being much more broad, and less long; and the crop was so much better in quality, as well as much more abundant, that I can confidently recommend the mode of culture adopted to every gardener.”—(*Enc. of Gard.*, 3850, from *Hort. Trans.* II. 98.)

667. *Taking the Crop.*—Observe the directions given for garlic. If roots be occasionally required in June and July, a few may then be taken up for present use.

## PART II.

### OPERATIONS IN THE VEGETABLE GARDEN FOR THE MONTH OF NOVEMBER.

668. *Sow* early peas (25), and mazagan beans (22), also short-topped radish (350); to be covered with litter during hard frosts.

*Plant*, for seed, cabbage-stalks (113); also beet-root and carrot (74).

*Transplant* the August-sown cabbage plants (111).

*Earth up* broccoli, cauliflower, and cabbage plants; do the work effectually, drawing the earth close about the stems, and placing it ridgeways, but not so high as to bury any of the leaf-stalks.

*Take up* beet-roots, carrots, parsneps, and some celery; remove them to a dry cellar, or bury them in sand.

*Dress* artichoke (410), and asparagus beds (153).

*Routine culture.*—Dig and trench vacant ground, but choose the driest weather that the season will afford. Remove and protect endive (490); celery (366); also Cape broccoli and autumnal cauliflowers, by placing them in an out-house, immersed in sand to the

lower extremities of the flower-stems, where they ramify from the stalk. By such means, these choice vegetables may be had during the depth of winter.

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### SECTION III.

#### PART I.

#### NATURAL HISTORY AND CULTIVATION OF THE GRAPE-VINE.

THE GRAPE-VINE:—*Vitis Vinifera*; *Ampelideæ*. Class v. Order i.  
*Pentandria Monogynia*, of Linnæus.

669. *The grape-vine* is a deciduous climbing tree or shrub, with long flexible branches, and jointed shoots, furnished with large, cut or entire leaves, that usually are divided into three or five lobes. The leaves sprout from the joints, and are attended with opposite tendrils or claspers—(*Cirri*)—that lap round the twigs or spray of neighbouring trees, and thus enable the vine, in its native country, to climb to a very considerable altitude.

The generic character of the genus *Vitis*, is—*Calyx*, five-parted. *Petals*, five-small, deciduous. *Germen*, oval, with no style, surmounted by an obtuse stigma; the germen becoming a roundish, or oval berry; unilocular, or of one cell, containing from two to five seeds, that are pointed at one end. The *flowers* are produced in large oblong racemes or clusters on the shoot of the current year's growth: they are of a greenish colour, and emit a deliciously fragrant odour, equal to, though not exactly resembling that of mignonette; they generally appear in June. The succeeding clusters of berries are the *grapes*, (from the French *grappes de raisins*,) each single berry of which, according to the variety, is in shape, either globular, oval, ovate, or oblong; and in colour, green, white, red, yellow, amber, black, or a variation of some of those tints. “Every berry ought to enclose five small heart or pear-shaped stones; though, as some generally fail, they have seldom more than three, and some varieties, as they attain a certain age, as the Ascalon or sultana raisin, none.”

670. *The vine appears to be of Asiatic origin*.—Humboldt says, “The vine which we now cultivate, does not belong to Europe; it grows wild on the coasts of the Caspian Sea, in America, and in Caremania. From Asia it passed into Greece, and thence into Sicily. The Phoceans carried it into the south of France; the Romans planted it on the banks of the Rhine. The species of *vitis* which

are found wild in North America, and which gave the name of the land of the vine (*Winenland*) to the first part of the New Continent which was discovered by Europeans, are very different from our *Vitis Vinifera*.—(*Géographie des Plantes*.)

The *Encyc. of Gardening* informs us, that “the *native country of the vine*, like most of our acclimated fruits, is generally considered to be *Persia*; and Dr. Sickler (*Geschichte des Obst. Cult.*, Vol. I.) has given a learned and curious account of its migration to Egypt, Greece, and Sicily. From Sicily it is supposed to have found its way to Italy, Spain, and France; and in the latter country it is believed to have been cultivated in the time of the Antonines, in the second century. It has been found wild in America, and is now considered as a native, or naturalized in the temperate climates of both hemispheres. In the old world, its culture forms a branch of rural economy from the 21st to 51st degree of north latitude, or from Schiraz, in Persia, to Coblenz, on the Rhine.”—“The introduction of the vine into Britain is supposed by some to have taken place under the first Roman governors, though, from Tacitus, it appears to have been wanting in Agricola’s time. There is evidence, however, to prove that vineyards were planted here in the year 280, A.D., and Bede, writing in 731, says, there were vineyards growing in several places.”—(Nos. 4792-3.)

It would be superfluous to multiply remote evidences, for one recently furnished by the late Honourable Charles Hamilton, of Pain’s Hill, in Surrey, is sufficient, and cannot be controverted. He himself observes, “It would be endless to mention how many good judges of wine were deceived by my wine, and thought it superior to any champagne they had ever drunk: even the Duc de Mirepoix preferred it to any other wine. But such is the prejudice of some people against anything of English growth, I generally found it most prudent not to declare where it grew till after they had passed their verdict on it. The surest proof I can give of its excellence is, that I have sold it to wine merchants for fifty guineas a hogshead: and one wine merchant, to whom I sold five hundred pounds worth at one time, assured me, he sold some of the best of it from seven shillings and sixpence to ten shillings per bottle\*.” The vineyard at Pain’s Hill, was situated on the south side of a gentle slope, the soil being a gravelly sand. It was planted entirely with two sorts of Burgundy grapes: the *Aternat*, which is the more delicate and tender, and the *Miller’s* grape, (originated by Miller, from seed, about 1730,) now called Miller’s Burgundy.

\* The process as described by Mr. Hamilton, may be found in *The Family Receipt Book*, pages 201-2.

It is no wonder, after such facts, that Professor Martyn should advocate *the re-introduction of vineyards*, and the renewal of grape-culture in this country, for the production of wine. I shall not now enlarge upon the subject, reserving what I have to say to a future occasion, in a Treatise connected with other branches of domestic productive economy. It will suffice to observe, that *ripe grapes* are not exclusively required for effecting a perfect vintage: immature grapes, nay, even grape-leaves will, with proper management, produce excellent, and very cheap wine; and therefore, if the fruit will not at all times and seasons attain to perfect maturity, there is no season in which leaves and green grapes will not be borne by the vines; and from either, or both of these, wine of superior quality, as has been said, can be made.

671. *Varieties*.—These are numerous. “Tusser, in 1560, mentions only ‘white and red’ grapes. Parkinson gives, in 1627, a list of twenty-three sorts, including the white muscadine, ‘very great, sweet, and firm; some of the bunches have weighed six pounds, and some of the berries half an ounce.’ Ray, in 1688, enumerates twelve sorts as then most in request. Rea, in 1702, gives most of those in Ray’s list, and adds five more sorts, recommending the red, white, and the d’Arbois, or royal muscadine, the Frontignacs, and the blood-red, as the fittest sorts for England. The best vines, he says, were then on the walls of the physic garden at Oxford.—(*Encyc. of Gard.*)

I select the following, from among the fifty-six vines which are described in Loudon’s Catalogue, No. 4802.

#### GRAPES WITH ROUND BLACK BERRIES.

No.	Names.	When Ripe.	Flavour and Character.
1.	July, or Noir Hatif.	September.	Sugary; ripens early.
2.	Muscadine, or Black Frank- endale.	September.	Rich and juicy; a good bearer.
3.	Frontignac or Muscat Noir de Frontignac.	October.	Rich and vinous; much esteemed.
4.	Claret; Clairette; Rose.	October.	{ Austere; berries black; juice, blood-red; leaves red in October.
5.	Black Prince.	October.	Ripens well on a wall.
6.	Turner’s hardy; or Black Es- perance.	Not named.	Very hardy and prolific.

#### GRAPES WITH LONG BLACK BERRIES.

7.	Black, or old Hamburgh.	Late.	Vinous; one of the best grapes.
8.	Miller’s Burgundy, or Cluster.	October.	{ Pleasant, hardy; used at Pain’s Hill.

## GRAPES WITH ROUND WHITE BERRIES.

No.	Names.	When Ripe.	Flavour and Character.
9.	Royal Muscadine; or Chas-selas Blanc.	September.	Rich and vinous; excellent bearer.
10.	Sweet Water.	September.	Sugary; an excellent grape.

## GRAPES WITH LONG WHITE BERRIES.

11.	White Muscat of Alexandria.	Late.	{ Rich, juicy, and vinous; one of the richest grapes.
12.	Syrian.	Late.	{ Harsh flesh; a great bearer; the largest as to bunches and berries.

672. *Propagation* is effected by sowing the *seed*, with a view to obtain new varieties. By *cuttings*, in order to ensure an equable developement of roots and shoots; for as each advancing bud produces a corresponding set of roots, it is clear that just so many roots will be protruded as the shoots require for their due support, and no more. By *layers*, to obtain strong and vigorous plants with the greatest certainty, and least expense of time; and finally, by *inarching* or *grafting*, to promote hardihood of constitution, and to introduce several varieties into one and the same stock.

673. *Propagation by Seed*.—Select the finest and ripest berries, from the largest and best grown bunches; separate the seeds, and sow them, either immediately, in pots of light sandy compost, rich with vegetable mould, in order to protect them under cover, during the winter, or keep the seeds in dry sand till the spring, as directed for apple-pips.

The object may be, thus to multiply an approved variety, or to obtain a new sub-variety from an esteemed fruit; but if it be to procure an entirely new variety, it will be necessary to cut out with a small, sharp-pointed scissors, the stamens of all the flowers which it is intended to breed from, and to impregnate their pistilla with the farina of another variety. The excision must be performed before the bursting of the anthers; and the crossing should be effected between plants of rather opposite characters. On this subject Speechley observes, "Were the red frontignac and white sweetwater wedded together, their union would probably produce a very valuable sort, as there would be a good chance of its being both large, delicate, and well flavoured. The Syrian vine is only admired for producing most astonishingly large bunches, and therefore, I would not advise the joining this coarse sort to any other except the following, as in all likelihood, the offspring would only produce bunches much less ponderous. But the white muscat of Alexandria, having larger

berries, and longer foot-stalks, there would be a probability of producing a kind between this and the Syrian grape, that would exceed the original parents both in size and flavour." Speechley recommends the union of the sweetwater with the white muscat of Alexandria, and with various sorts that produce smaller and less delicate berries. The junction of the black Damascus, and the grizzly Frontignac; that of the black Frontignac and the white muscadine; and that of the St. Peter's grape, and white muscat of Alexandria, may also be effected with every prospect of success.

"*Grapes for seed* should be permitted to remain on the plant till the fruit is perfectly mature, and the seeds of a very dark brown colour. They should be separated from the pulp, and preserved till February, or the beginning of March. They should then be sown in pots filled with light fresh mould, and plunged in a moderately-warm hot-bed; they will come up in four or six weeks, and when the plants are about six inches high, they should be transplanted singly into forty-eights, and afterwards into pots of larger size. Water gently, as circumstances require, allow abundance of light and air, and carefully avoid injuring the leaves. Cut down the plants every autumn to two good buds, and suffer only one of these to extend itself in the following spring. Shift into larger pots, as occasion requires, till they have produced fruit. This, under good management, will take place in the fourth or fifth year, when the approved sorts should be selected, and the rest destroyed, or used as stocks on which to graft or inarch good sorts."—(*Encyc. of Gardening*, 4805-6.)

674. *Some of the most valuable grapes* have been procured by sowing the seeds of fruit ripened in this country. Thus, it appears, that "the red Hamburgh was raised from seed, about a century ago, by Warner, of Rotherhithe. Miller produced the variety of the black cluster, which bears his name. Speechley produced various new sorts which have now a place in the catalogues of nurserymen. Williams of Pitmaston, Braddick of Thames Ditton, and above all, the president of the Horticultural Society, have raised several excellent varieties of the sweetwater, Chasselas, and Hamburgh grapes."—(*Idem*, 4799.)

675. *Propagation by Cuttings*.—This is effected by three distinct modes of operation: by long cuttings, by short cuttings, and by cuttings with single eyes.

(1.) *By long Cuttings*.—"Cuttings of the young shoots are to be provided in winter, or early in the spring, before the sap is in motion, for planting in March and April. Select strong young shoots of the last summer's production, that are firm and well

ripened, and principally the lower and middle parts of the shoots, as being the best ripened. Cut them into lengths of twelve or fifteen inches, or about three joints, and the lower cutting may be taken off with an inch of the two-year old wood at the bottom, though this is not of material consequence. Being thus provided, plant them, either directly in dry warm ground, or lay them in a bundle together in a dry border, with the ends in the earth, and cover them with litter in frosty weather occasionally, till spring; then plant them out separately in February, March, or the beginning of April—both in rows in the nursery, to form rooted plants for future transplanting—and others, at once where they are to remain, against walls, espaliers, or in the vineyard way, opening the ground with the spade, and introducing each cutting into the earth, quite down to the uppermost bud. They will root freely the same season, and shoot at top, and from all the lateral eyes. Of these shoots none are to be left but the principal or mother shoot, trained up at full length all summer; and in autumn, when the leaf falls, this shoot is to be pruned down to two or three eyes, according to its strength.”—(ABERCROMBIE.)

The *Encyclopædia of Gardening* directs the ground about the cuttings to be mulched, and water supplied regularly, in dry weather. “Cuttings of this sort, so treated, strike freely, as Speechley observes, either with or without bottom heat. We have seen them in some French nurseries producing luxuriant shoots and bunches of grapes the first year. Justice says he prefers stocking a vinery from such cuttings, to using rooted plants.”—(No, 4810.)

(2.) *By short Cuttings.*—This second mode is thus described by Speechley. “Each cutting should have two inches of the old wood”—that is, of the two-year-old wood—“and one eye of the new. The bottom part should be cut perfectly smooth, planted in pots, one cutting in each pot, which, as to size, should be a forty-eight. When the plants begin to get strong, and the pots full of roots, it will be necessary to shift them from the forty-eights to thirty-twos.”—(*Idem*, 4811.) This is unquestionably an excellent and very ready mode of propagation, as it enables the gardener to place the pots over a slight bottom heat, produced by a body of tree-leaves or grass, covered with mould. Cuttings struck in pots, form a compact body of roots, and thus the plants may be safely removed with the ball entire.

A very good method to obtain fine young vines, in the shortest possible period, is to take cuttings of old wood, no matter if of five or six years, a foot or eighteen inches long, with a small bit of young bearing wood at the top of it. Prepare a pot (32 size),

about five or six inches across the rim, and place a layer of chips of pots at the bottom, an inch deep, to act as drainage. Pass the cutting in an oblique, half-spiral direction against the side of the pot, so that its heel rest on the potsherds, and the spur of new, or last year's wood, against, and about an inch below, the rim. Holding the cutting firmly in this direction, secure it by pressing in a light, turfy, sandy loam, chopped finely up with about one-fourth of new rich, black manure: the earth must just cover the buds on the young spur. Thus the entire cutting will be concealed. Mark the variety on a tally, plunge the pot to its rim in a hot-bed of dung, leaves, or tan, heated to 80° or 90° in a close pit, or frame.

The soil must be kept free, and just so moist as to excite vegetation, but by no means wet. The old wood will have no spur or eye left upon it, excepting the one at its summit, which, stimulated by the volume of nutritive sap in the wood, will send up one strong shoot at the least; or if two grow, one only, the strongest, must be selected. Roots will be produced in abundance, and the plant may be shifted twice into a larger pot, as the smaller becomes filled. The bottom heat need not be continued after the second potting. February is the proper season, and if the plants be scientifically treated, as respects water, sun, and air, fine rods, from five to ten feet long, will be the result, strong enough perhaps to produce a crop of grapes in the following year, if treated as a potted vine.

(3.) *By single eyes.*—This method was introduced by the Rev. M. Mitchell, in 1770, and by him communicated to Speechley\*, who, in noticing his method, observes, that “Very strong shoots abound too much in pith to make good cuttings, the requisites to which are as follows:—1. The eye, or bud, should be large, prominent, and bold. 2. The shoots should be moderately strong, round, and short-jointed. 3. The texture of the wood should be close, solid, and compact; and the best criterion of its maturity, is its solidity, and having very little pith.”—(*Treatise on the Vine.*)

“Choose fit shoots in the pruning season, and preserve them till wanted in the spring, by cutting them into moderate lengths, and placing their lower ends in earth, which must be moistened if it get very dry. Cut the upper part of the shoot sloping, with a sharp knife about a quarter of an inch above the eye, and at about three inches below the eye cut off the wood horizontally, or right across, and smooth the section.”—(*Encyc. of Gard.*, 4812.)

\* William Speechley, so frequently referred to, was gardener to the Duke of Portland, at Welbeck, in Nottinghamshire: he was celebrated for his method of cultivating the vine, and wrote a *Treatise* on the subject. He died at an advanced age in 1820.

Some direct to shave off the bark and a little of the wood, on the side of this short piece opposite to that of the bud or eye; and that the whole piece be then buried in good light earth, in a largish pot, to the depth of two inches, keeping the bud upwards, and pointing towards the surface of the mould: the operation is to be performed in February.

*Cuttings of the Spur-eyes*, that is to say, pieces (with a bud or two upon each) of the wood of the last year, proceeding from a branch of older wood,—are now particularly recommended. It is of no consequence how old that wood is, provided it be furnished with a *spur*, from an eye of which a young prolific shoot would be produced. Speechley's short cuttings (No. 2) somewhat resemble the spurs now alluded to; the difference between them is this, that whereas the *short cutting* consists of two inches of two-year old wood and one eye of the last year's wood, the *spur-eye* has one or two minute buds at the base or heel of *bearing spur*, which is borne by a shoot of any age. A piece of this old wood is said to supply ten times more food to the young sprouting eye than is furnished by the mere bit of the last year's wood which remains on each side of the single eye described above (3).—See the *Gardener's Magazine*, Vol. VII. p. 484, and also a *figure* given in the *Hort. Reg.* Vol. I. p. 572.

*Propagation by Layers*.—Layering may be done in autumn or spring. Abercrombie's directions are to choose the outside lower branches, of one or two years' growth, and making an oblong opening in the earth, three or four inches deep, lay the branch or shoot therein, a foot or more, lengthways, with its upper part out of the ground: and peg it down with a long, hooked, or forked stick, covering the body of the layer with earth, and shortening the long weak top to two or three buds. They will be well rooted by the next autumn: then cut them from the parent plant, when they may be planted, either in a nursery, for training a year or two, or, at once where they are always to stand; observing, if they are now furnished with young shoots of last summer, to let the said shoots be pruned to three or four buds, which, in the following summer, will each produce a strong shoot, that must be trained at full length during the summer's growth; and all lateral twigs rising therefrom, must be carefully rubbed off, leaving only the main shoots."—(*Pocket Dictionary*, *Vitis*.)

676. "*Layering without, or with a very trifling incision*," London observes, "as is too frequently done in the hurry of nursery business, greatly contributes" to leave the roots in an unripe state, "by obliging the shoot to derive all its nourishment from the parent plant or stool to which, in autumn, the descending sap is returned.

Whereas, when a deep incision is made, or a ring of bark taken off in Williams's manner, less sap ascends, the shoot is not so long, it ripens sooner, and the descending sap reposes in and ripens the roots. It is not easy to conceive in what way plants so raised can be inferior to those raised from cuttings of one or several eyes; though it appears to be the general opinion that they are not so long lived as plants raised from an eye. 'Vine-plants raised by layers,' Speechley observes, 'are much inferior to plants raised by cuttings, both in point of future vigour and durability.' Hitt wonders how any one can prefer cuttings to layers, since the former are always one year behind the latter."—(*Encyc. of Gard.*, No. 4808.)

677. Thus authorities differ; and, therefore, actual experiments alone can decide the comparative merits of the two modes of operation; one, I shall shortly recite, and in the mean time observe, that, in the *ringing* above alluded to, Williams, of Pitmaston, took off rather less than a quarter of an inch from the stem of a vine; and his object was, by the annular excision, to promote the *maturation* of the fruit, not the *propulsion* of roots. However, the plan is a good one, and may safely be adopted in propagating by layers (No. 623). As to the general result of layering, the following statement of the experiment alluded to above, may be adduced in support of those who argue for its excellence, if not superiority. In the autumn of 1826, a fine black grape just coming into full bearing, produced a shoot that was very favourably situated for forming a layer. A pot of about six inches wide and seven inches deep (a sixteen), was raised four feet from the ground, and supported firmly on a bracket. The shoot was then notched at a convenient part, and so bent into the pot that it formed a curve, the centre of which approached the bottom of the pot, while the upper part came in contact with the side of the pot, and was thence carried up in a perpendicular direction, and fastened by shreds and nails to a corner of the wall, where the bracket was fixed. The pot was then filled with good garden earth. The layer was of the previous summer's wood: it was about four feet long, and was cut to about two feet above the pot. I did not at the time notice dates particularly, nor did I,—as I now would do, and recommend to be done,—*ring the bark* about two inches *below a joint*, and *pierce that joint* twice through, in a cross direction, with an awl; but still, within a year from the time of layering, the plant was separated from the parent, was turned out of the pot with a ball of roots that had filled it, and was planted against a wall, which it now covers. It bore a few bunches in 1828, and last summer, nearly one hundred. The tree consists of three main branches trained horizontally one above the other, for the situation

is peculiar: they rise from one main stem. Each branch extends to the length of about ten feet, and the three are furnished altogether, with thirty-two perpendicular bearing shoots.

678. *Propagation by Inarching and Grafting.*—The season for grafting in the open air, is about the middle of March. As, however, it is an acknowledged fact that vine-grafts do not take so freely as those of most other fruit-trees, the most certain mode of proceeding is to graft by approach—that is, by *inarching*. Either the stock or the scion must, in this case, be growing in a pot, and for the former, strong plants that have been potted two years—or rather, that have been *raised* in pots—are to be preferred, because they will be more perfectly rooted.

679. The *operation of inarching* may be performed in the usual manner with the dry wood, but it rarely succeeds with the vine. The method of inarching with green wood rarely fails: it is one of the most certain and gratifying operations of the nursery. By it any of the vines may be changed, for it appears to correct defective stocks, transferring such as cannot produce good fruit into efficient supporters of perfectly prolific varieties. In some places the Frontignacs constantly fail as primary plants, but when inarched, they bring their scions to the highest condition of fertility; and in other genera. analogy appears to bear out the fact. In April, May, or June, any strong young shoot produced from, or near the lower part of a stem, the wood of which, though quite green, has acquired some firmness and elasticity, is fitted to receive a scion of another vine, whether growing in the border or in a pot. An incision is to be cut so deep in the stock, and another in the scion, as to admit of the best adjustment of the wounded bark and alburnum, on both sides if possible. The *green wood of the scion* may be rather more tender than that of the stock; but it should be firm enough to bear the ligature. Let an inch and a-half, or two inches, be taken off from each; then fit the abraded surfaces, and tie them closely with a soft, strong shred of moistened bass-matting: cover the parts with moss, and confine it over the ligature. In six weeks the junction will generally be secured. In the mean time, the lead of the stock must be stopped, and not suffered to outrun the scion. In 1837, I inarched a Frankendale slender scion upon a secondary, *low* shoot of a Hamburgh: a Hamburgh and several Frankendales upon green shoots advancing from the lowest portion of the stem of a white Frontignac, all within two or three feet of the border. I obtained above twenty feet of strong bearing wood from the two Hamburgh inarches: one shoot of equal length from a Frankendale, and others of less extent. All the scions of the Frankendale were very slender, being the products of weak,

potted plants. When the junction is assured, cut back the stock to the scion; stop the latter to one or two eyes to force it to produce a strong shoot; but do not separate the scion from its parent till the wood ripens. Inarching is required:—

“*First*, when a wall, or vinery, is planted with inferior kinds of vines, the usual method of stubbing them up and supplying their places with better sorts, is attended with much expense and loss of time; as several years must elapse before the wall can be completely furnished with new vines; but, by grafting, the nature of the vines may be changed without expense, or loss of time; for I constantly have good grapes from the same year’s graft; and in a hot-house, the grafts, if permitted, will frequently shoot thirty or forty feet the first summer.

“*Secondly*, in small vineries, or vine-frames, where it would be inconvenient to have a considerable variety of sorts from roots, they may be procured by grafting different kinds upon one and the same plant. A Syrian vine now (1759) growing in the hot-house at Welbeck, produces sixteen different sorts of grapes.” The most important advantage Speechley considers to be, “the improving the various kinds of grapes, and particularly the small kinds, which generally make weak wood. By grafting the weak and delicate growing vines, as the blue Frontignac, upon robust and vigorous stocks, as the Syrian, it will produce well-sized handsome bunches, almost as large as those of the Hamburgh. The Syrian vine raised from seed, is greatly preferable to all others for stocks. If the seed degenerate to a kind of wildness, so much the greater will be the vigour of the plants, and the higher the flavour of the sorts grafted on them\*.”—(SPEECHLEY’S *Treatise*.)

\* The subject will be continued in the third section of the ensuing month.

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## PART II.

## OPERATIONS IN THE FRUIT DEPARTMENT

680. *Plant* fruit-trees of every kind, but choose dry weather.

*Mulch* newly-planted trees, with long litter, tan, or cow-dung.

*Gather* late pears or apples; and store them up in dry fruit-rooms, from which actual frost can be excluded.

*Prune* vines: other fruit-trees may also be thinned out and trained; but avoid shortening the branches till February or March.

## MISCELLANEOUS.

*Plant* tulips, hyacinths, jonquils, crocuses, and other bulbs; and attend to the directions given last month, in order to complete what may then have been omitted.

## THE NATURALISTS' CALENDAR.

## NOVEMBER.

Fogs, and a damp state of the atmosphere, are peculiarly prevalent this month; storms of wind and rain likewise, frequently occur; but still, there are intervals of fine and cheerful weather. Hoar frosts, it has been remarked, afford at this season of the year a criterion whereby to judge of the character of the ensuing winter; for, if after a frosty night, the wind veer to the south-west, and bring rain in a few hours, and this occur three or four times successively, or at short intervals, the succeeding winter will in general be mild and rainy.

The average height of the barometer is about 29 inches 74 cts.

Ditto thermometer, 43½ degrees.

*In the first week*,—In late seasons, stares or starlings (*Sturnus vulgaris*), congregate; late house martins (*Hirundo urbica*), disappear.

*Second week*,—Redwing thrush (*Turdus iliacus*), comes; golden plover (*Charadrius pluvialis*), appears.

*Third week*,—The snipe (*Scolopax gallinago*), appears; snails (*Helix*), and slugs (*Limax*), bury themselves.

*Fourth week*,—Greenfinches (*Fringilla chloris*), flock; fieldfares (*Turdus pilaris*), arrive.

# DECEMBER.

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## SECTION I.

### SCIENCE OF GARDENING.

#### SCIENTIFIC OPERATIONS OF GARDENING.

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##### PART I.

##### OPERATIONS OF GRAFTING AND BUDDING.

681. By *grafting*, or, as it was formerly written, *graffing*, is to be understood that operation by which a young twig, generally of the last year's growth, or a bud (sometimes called a shield) of one tree, is inserted into some part of another tree, in order to bring about a union of the two for a specific object.

The operation of grafting includes a variety of processes, the principle of which is one and the same in all.

682. *Origin of Grafting—and of the term.*—The practice of grafting is one of great antiquity; and its origin may, in all probability, be traced to a natural process which is of no unfrequent occurrence. It has been observed that when two branches of a tree lie in close contact with, or overlap one another, a wound, or an abrasion of the two surfaces is produced, and the returning juices of the tree exuding from the ruptured vessels of the bark, produce granulations, by which a perfect incorporation of substance is effected, and the two branches become united into one. I have now before me an example of such a natural graft in an espalier apple-tree; two of the lower branches of which have united together, forming a double arch, the lower one inverted, leaving a small, but nearly circular hole between them.

Referring to the authority of Dr. Johnson for the derivation of the term *graft*, we find—

“To graft, to graff, verb active (*greffer*, French),—to insert a

cynon or branch of one tree into the stock of another.”—(*Quarto Dictionary*, 1786.)

Here, then, there appears to be some difficulty; for where are we to look for the origin of the word *cynon*? Will it be found in the word *cuneus*, a wedge—from *Kwvos*, a cone, or pointed peg? If so, it may be fair to conclude that the original method of grafting might resemble *that*, which we term *terebration* (from *terebro*, to pierce or bore), or *peg-grafting*, thus described in the *Encyclopædia of Gardening*.—It “is an old method, in which the stock being cut off horizontally, a hole was bored in the centre of it; and the scion being selected to fit the stock within an inch and a-half of its lower end, a circular incision was made, and the part between that and the end reduced, so as to fit the hole in the stock. The peg filling the hole was supposed to secure the graft from the effect of winds.”—(2038.)

683. *The object of Grafting* is to be considered as three-fold.—The first is to preserve or multiply those approved varieties of trees—fruit-trees, particularly—which cannot be propagated with any certainty of success from seeds; because the quality of the seed, as we have seen, is liable to be affected by impregnation, occasioned by the casual introduction of the farina of congenerous trees into the blossoms.—(See 601.)

The second is to accelerate fruitfulness by impeding the descent of the proper elaborated juices of the tree; thus promoting the principle of maturation, instead of that of growth.

The third is to induce fertility, and confine it within more contracted limits; this refers particularly to all those modes of operation by which dwarfing or reduction of size is produced. Grafting, then, may be rendered favourable to precocity, as well as to fertility. Mr. Knight observes, that the effects of grafting on the growth and produce of trees, “are similar to those which occur when the descent of the sap is impeded by a ligature, or by the destruction of a circle of bark. The disposition in young trees to produce and nourish blossom-buds and fruit, is increased by this apparent obstruction of the descending sap; and the fruit of such young trees ripens, I think, somewhat earlier than other young trees of the same age, which grow upon stocks of their own species; but the growth and vigour of the tree, and its power to nourish a succession of heavy crops, are diminished apparently by the stagnation in the branches and stock of a portion of that sap, which, in a tree growing upon its own stem, or upon a stock of its own species, would descend to nourish and promote the extension of the roots. The practice, therefore, of grafting the pear-tree on the quince-stock, and the peach and

apricot on the plum, where *extensive growth and durability* are wanted, is wrong; but it is eligible wherever it is wished to *diminish the vigour and growth* of the tree, and where its durability is not thought important.”—“When great difficulty is found in making a tree, whether fructiferous or ornamental, produce blossoms, or in making its blossoms set when produced, success will probably be obtained in almost all cases, by budding or grafting upon a stock which is nearly enough allied to the graft to preserve it alive for a few years, but not permanently.”

684. *Theory of Grafting.*—This has been deduced from repeated observations of natural phenomena; and its fundamental principle is, that *when the liber, or inner bark of two trees which are allied by a natural relationship, is brought into close contact, the two liber tend to unite and grow together.* This theory is ably elucidated by Keith, who, after referring to the natural union between two or more contiguous stems, already described, observes, “This is what may be termed a natural graft, in opposition to an artificial graft, of which it is the model and prototype; the whole of the art of grafting being founded upon the capacity inherent in plants, of uniting together by the stems in given circumstances, and in a given mode. But the natural graft is always effected by means of the union of the liber of the respective stems composing it; so that the perfection of the art of grafting consists in applying the liber of the graft and stock together in such a manner as shall most facilitate their incorporation. And hence the graft will not succeed, unless the two liber are brought into contact, and closely bound together. Nor will it succeed well, unless the plants ingrafted have some natural affinity to one another, as that subsisting between the plum and cherry; in which, and in all other cases, the union is effected by means of a granular and herbaceous substance exuding from between the wood and bark, and binding and cementing together the stock and graft, though not uniting the former layers of wood.”—(*Physiol. Botany*, Vol. II., p. 277.)

According to the *Encyclopædia of Gardening*, the theory of grafting comprises the following particulars:—

(1st.) “*To graft or unite only varieties of the same species; species of the same genus; and by extension, genera of the same natural family. Unless this union of natures be attended to, success will not attend the operation.*

(2nd.) “*To observe the analogies of trees, as to the periods of the movement of their sap; in the permanence or deciduous duration of their leaves; and the qualities of the juices of their fruits, in order to*

estimate the probable advantage of grafting a fruit of any particular flavour on another of similar or different qualities.

(3rd.) “*To unite exactly the inner bark of the scion with the inner bark of the stock, in order to facilitate the free course of the sap.*”

(4th.) “*To make choice of the proper season, and perform the operation with celerity.*”—(Nos. 2015, *et seq.*)

685. *Remarks.*—Much has been already said in pages 368-9, on the formation of the *liber* and *alburnum*; and at Nos. 706-7, on *The Science of Budding*, it will be seen that the bud or graft effects its own specific developements, and is in its nature wholly uninfluenced by the stock. Every bud or germ during its growth protrudes a system of fibres, and these become the future organs of supply to the advancing shoot; in a word, they constitute the alburnous vessels for conducting the ascending sap, and the reducent vessels of the liber for the descent and lateral distribution of the laborated proper juices.—(See No. 402.)

Since then the developements of the graft are proved to be, in fact, altogether uninfluenced by the stock, it may be safely asserted, that the latter ought to be considered as a medium only, or vehicle, through which the vascular organs of the former pass, and are conveyed into the soil\*; whence their spongiolæ and rootlets, by the aid of electric agency, effect the intro-susception of the nutritive sap. It may, however, be admitted, that, in the first instance, the *cellular system* and *juices* of the stock exert an attractive energy upon those of the graft; and that, while the former affords an appropriate matrix or bed, wherein the granular exusions from the scion may affix themselves and be secured, the latter keeps up that supply of moisture which is required, till the union is completely effected.

A graft or scion, therefore, can be viewed in no other light than as a *cutting* deposited in a more congenial medium of nutrition than that of the soil; all the future developements of which cutting are completely its own, and wholly independent of any physical agency or influence exerted by the stock.

686. It has been erroneously supposed that *a scion would succeed upon any stock*. Thus, among the ancients, “Pliny, Varro, Columella, &c., speak of apples and vines grafted on elms and poplars, though they acknowledged that such grafts were but of a short dura-

\* In order to place the theory of grafting in a philosophical point of view, the reader's attention is particularly directed to the paragraphs Nos. 325, 328, 404, 405; to Dr. Aikin's hypothesis of the developement of buds, at No. 525; to Sir Humphry Davy's observations, at No. 693; and to Mr. Knight's remarks on side-grafting, at No. 694.

tion." Evelyn, among the more modern writers, mentions a rose that he saw grafted upon an orange-tree, in Holland; and some, even at the present period, will speak of the practicability of grafting a rose upon a black currant, and thereby producing black roses. But as Professor Thouin remarks, "if any of these grafts seem at first to succeed, they all perish more or less promptly."

One of the neatest grafts I ever saw, was that of an apple upon a hawthorn (*Mespilus oxyacantha*). The stock and the scion fitted to exact precision; and though the junction was tardily effected, the two appeared at length to knit together, so as to form a perfect union. But the future growth was confined exclusively to the stock. It continued to protrude buds and young branches, while the scion could barely effect the developement of a few weak and sickly leaves during the whole summer, and in the course of the first autumn it perished.

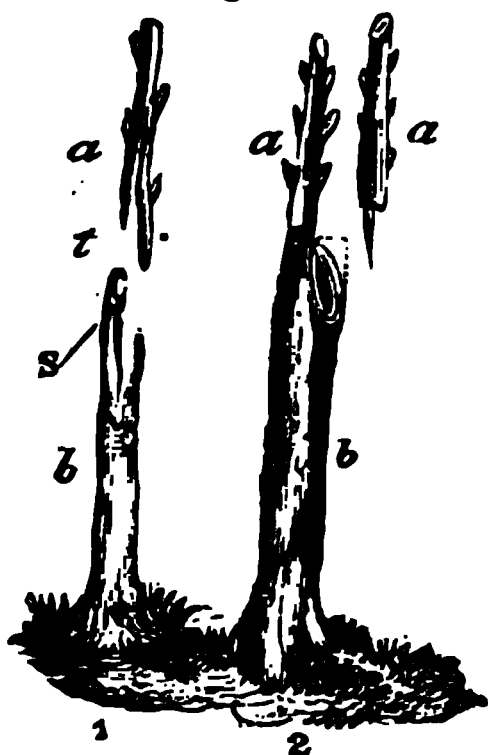
687. *Varieties of Grafting*.—Professor Thouin, author of the *Monographie des Greffes* (4to., Paris, 1821), has enumerated above forty modes of grafting; most of them, however—the *Encyclopædia of Gardening* observes—are varieties of the ordinary species, separated by very slender shades of difference, or remotely connected with utility.

It will be necessary to describe somewhat particularly, three of the most approved methods of performing the work: these are,—whip or tongue-grafting,—cleft-grafting,—and crown-grafting. To these will be added, saddle and root-grafting, as practised and described by Mr. Knight,—inarching, or grafting by approach,—and, finally, grafting by inoculation or budding. I shall point out by italics those passages in the annexed quotations that appear to me to require peculiar attention, and that tend to illustrate the *theory*, or are themselves elucidated by it.

688. *Whip or Tongue-Grafting*, from the *Encyclopædia*.—It is desirable that the top of the stock and the extremity of the scions should be *nearly of equal diameter*. Hence this variety admits of being performed on smaller stocks than any other. It is called whip-grafting, from the method of cutting the stock and scions sloping on one side so as to fit each other, and thus tied together in the manner of a whip-thong to the shaft or handle. The scion, *a*, and stock, *b*, fig. 33, 1, "being cut off obliquely at *corresponding angles*, as near as the operator can guess, then cut off the tip of the stock obliquely, or nearly horizontally; make a slit near the centre of the sloped face of the stock, downwards, *s*, and a similar one in the scion, upwards. The tongue, *t*, or wedge-like process forming the upper part of the sloping face of the scion, *is then inserted down-*

wards in the cleft of the stock; the inner barks of both being brought

Fig. 33.



closely to unite on one side, so as not to be displaced in tying, which ought to be done immediately with a riband of bass, brought, in a neat manner, several times round the stock, and which is generally done from right to left in the course of the sun. The next operation is to clay the whole over an inch thick on every side, from about half an inch or more below the bottom of the graft, to an inch over the top of the stock, finishing the whole coat of clay in a kind of oval globular form, closing it effectually about the scion and every part, so as no light, wet, nor wind may penetrate; to prevent which, is the whole intention of claying. It may be

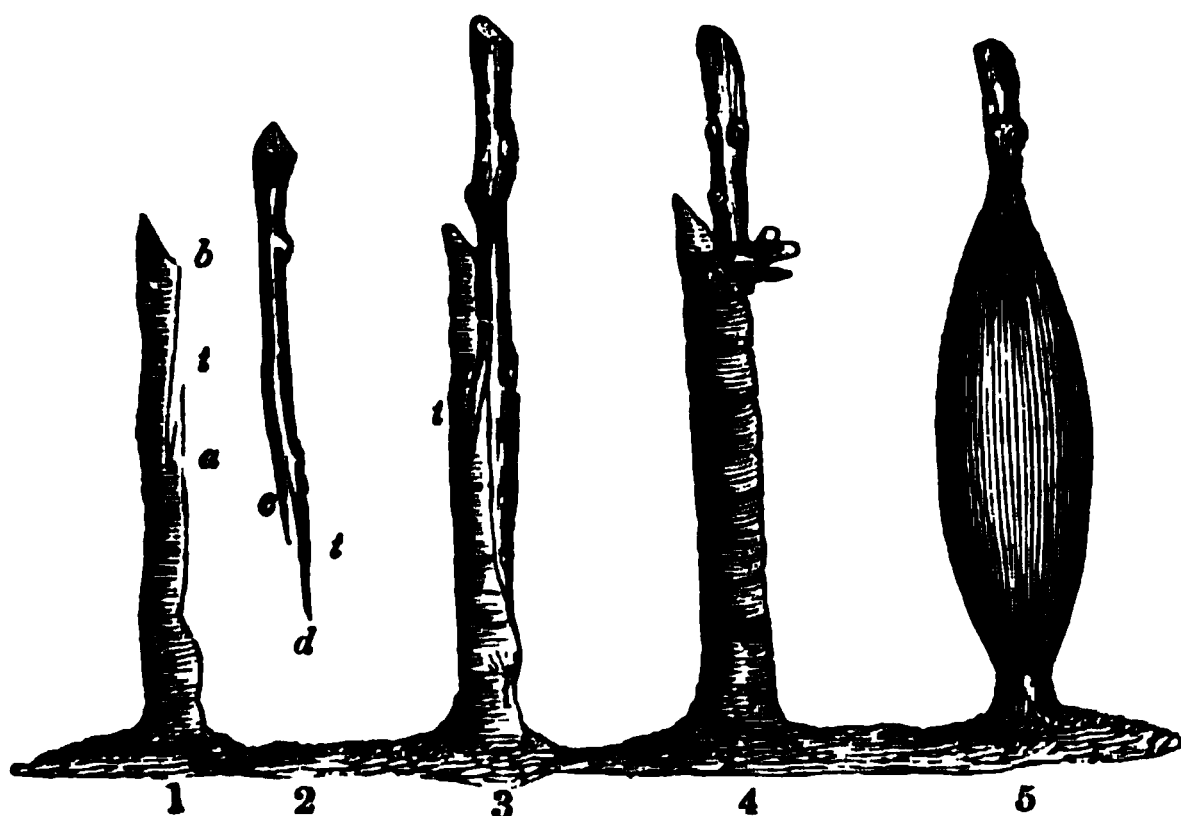
added, that the whip-grafting of Lawson, and other old horticultural writers, was then practised without a tongue, which addition gave rise to the latter term. *The French mode of whip-grafting differs from the English in their never paring more off the stock, however large, than the width of the scion.* In both modes, the stock is sometimes not shortened down to the graft, but a few inches left to serve as a prop to tie the shoots proceeding from the scion, or even to admit of fastening the ligatures used in the operation more securely. In either case, this appendage is cut off at the end of the season.”—*(Encyc. No. 2028.)*

689. *Tongue-grafting*, according to the *English Gardener*.—By comparing the foregoing quotation with the following most perspicuous directions and their corresponding figure, the difficulties attendant on the operation will be much lessened. The author premises that the *time of grafting* is generally from the beginning of *February to the end of March*, beginning with the earliest trees—as plums, cherries, and pears, and ending with apples. The scions, *from a healthy young tree*, are to be selected from the outside shoots, because those from the top or middle of the tree are more likely to produce wood shoots than fruit. If the tree be old and sickly, the most vigorous shoots from any part of the tree ought to be taken. Each scion should have from three to six eyes on it,—in all cases, the latter number will be sufficient. With respect to the age of the stocks, if they be young seedlings, they may be from three to five years old; and it is required that each stand one *whole summer* upon the spot where it is to be grafted or budded, before that operation is performed upon it. “If stocks be planted out in the fall, the sap

does not rise vigorously enough in the spring to afford a chance of the growing of the graft; but another remark of equal importance is, that fruit-trees should stand *only one summer* on the spot, whence they are to be removed to their final destination; because, if they stand longer than this, they will have large and long roots, great amputations must take place, and the trees suffer exceedingly."

In the following figure (34), the parts laid down are about one-fourth of the natural size; consequently, they convey a more definite idea of the due proportions of the stock and graft, than when they are much contracted. The plan will appear to correspond somewhat with the French method of whip-grafting, referred to at the close of the quotation from the *Encyclopædia of Gardening*. The directions are, of necessity, somewhat abbreviated.

Fig. 34.



690. *Mode of Operation*.—"The stock being ready, cut it off at three or four inches from the ground, and with a very sharp, straight, and narrow-bladed grafting-knife, cut a thin slip of wood and bark upward, from about *two inches* below the top of the shortened stock. Make this cut at one pull of the knife, inserting the edge rather horizontally, and when it has gone through the bark and into the wood a little short of the middle, pull straight upwards (see No. 1, *a, b*). Then, at less than half-way down this, cut a *thin tongue* (No. 1, *t*), not more than three-eighths of an inch long. Proceed in the same way with the bottom part of the scion; make a sloping cut (No. 2, *c, d*), of about the same length as the cut in the stock; then make a tongue (No. 2, *t*), to correspond with that in the stock (No. 1, *t*); but cut *upward* instead of *downward*. Then place the scion upon the stock, inserting the tongue of the

scion into the tongue of the stock. Bring the four edges of the bark—that is, the two edges of the cut in the top of the stock, and the two corresponding edges of the cut in the bottom of the scion, to meet precisely; or, if the scion be in diameter a smaller piece of wood than the stock, so that its two edges of bark cannot both meet those of the stock, then let only one meet, *but be sure that that one meets precisely*. But observe well, that this can never be, unless the first cut in the stock and that in the scion be as even as a die, and performed with a knife scarcely less sharp than a razor.” The two parts thus joined (and presenting the appearance as at No. 3, the tongues of the stock and graft clasping one another, as at No. 3, *t*), “must be bound closely to one another by matting, or bass, as the gardeners call it.” (See No. 4.)—“A single piece tied on to the stock an inch or so below the part grafted, and then wound closely up till it reach the very top of the stock, will, if well done, almost ensure the junction; but, lest parching winds should come, and knit up all vegetation, it is usual to put on, besides the bandage of matting, a ball of well-beaten clay, sprinkled over with a little wood-ashes, or the fine siftings of cinders, to cover completely the parts grafted—that is, from an inch below them to an inch above them” (as at No. 5), “and even to prevent this ball of clay from being washed off by heavy rains, it is well to tie round it a covering of coarse canvass, or else to earth up the whole plant as you do peas or beans, drawing a little mound round it so as nearly to reach the top of the clay.”—(*Eng. Gardener*, 206—209.)

691. *Cleft-grafting* is the peculiar and favourite method of grafting in some of the western counties. It is practised by almost every cottager, who frequently inserts from twenty to sixty scions into one tree. He saws off the head of his stock, or the tops of those branches he wishes to graft,—splits the stump or limbs with a strong knife and hammer, or even with a bill-hook, in the absence of a more refined tool,—cuts his graft into a shape somewhat like the blade of a razor, to the length of two inches; that is, about the eighth of an inch broad on one side, with the bark entire, and its edges smooth and even, and the other side pared to a sharp edge: he then forces open the split with a chisel, and passes the scion into the cleft, bringing the two edges of its bark into close and exact contact with the two edges of the bark of the cloven stock—the sharp edge entering the wood, and facing in the direction of the pith. The chisel is then withdrawn, the limb is tied round with soft string, and the stock and graft are clayed over, as in the case of whip-grafting. I have described the process thus roughly, because, in point of fact, no delicacy or ceremony is employed: the work—

to use a familiar phrase—is “knocked off” at once. The tree or limb is split without regard to the pith, the scion is cut from the tree at the moment it is wanted, it is pushed into the cleft, tied, clayed over, and left. I would observe, that the better and the more adroitly the operation is performed, the more pleasant may be the feelings of the operator; but still, as despatch seems to be the great requisite, other considerations are often made to give way to that. The wedge-like blade, however, should be so cut as to leave the sides and the bark as true and smooth as possible, so that the *four edges of the inner bark* may correspond exactly. March, or early in April, is the season for performing the work.

The reader will now compare the drawing at No. 2, figure 33—where *a, a*, represent the scion, and *b*, the stock—with the annexed figure, and the succeeding description.

Fig. 35.



Fig. 35, *a*, is a stock—one, two, or three inches broad; 2\ and 3/ point to places where two other clefts may be made, in the case of strong stocks; *s*, is the scion or graft, showing one surface of the wedge-like cut or blade; *g*, is the perfected graft, as it appears previously to binding and claying. Loudon says:—

“*Cleft-grafting* is resorted to in the case of strong stocks, or in heading-down and re-grafting old trees. The head of the stock or branch (which we may suppose to be two or three inches in diameter), is first cut off obliquely, and then the sloped part is cut over horizontally near the middle of the slope (Fig. 33, No. 2, *b*); a cleft, nearly two inches long, is made with a stout knife or chisel, in the crown downwards, or at right angles to the sloped parts, taking care not to divide the pith. This cleft is kept open by the knife. The scion has its extremity, for about an inch and a-half, cut into the form of a wedge; it is left about the eighth of an inch thicker on the outer or back side, and brought to a fine edge on the inside. It is then inserted into the opening prepared for it; and the knife being withdrawn, the stock closes firmly upon it. If it be intended to graft any pretty large stocks or branches by this method,

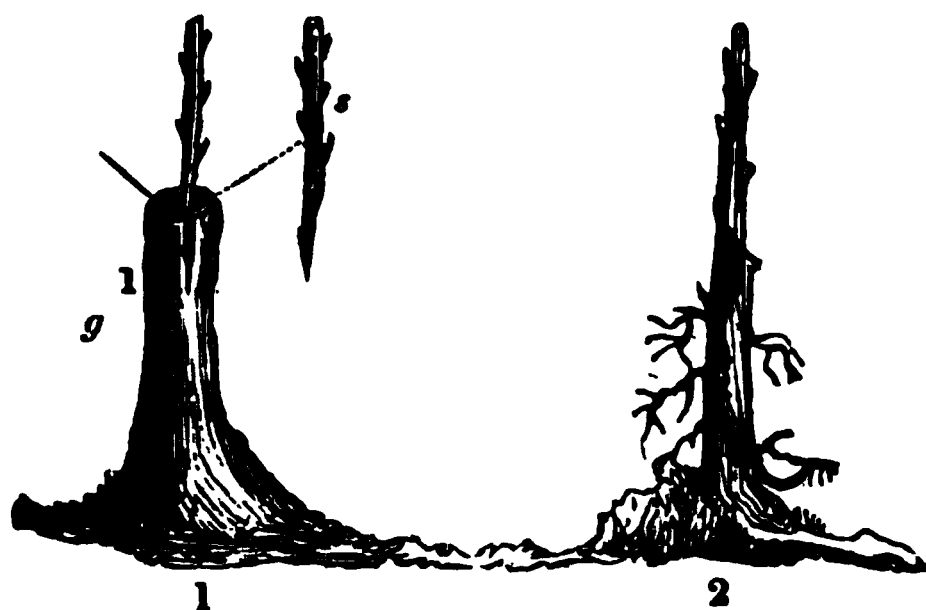
two or more scions may be inserted in each. The stock being prepared by cutting over as above, cleave it across in two places, parallel, and at a small distance apart, and insert a scion in each cleft; or by cutting or sawing the head off horizontally, and smoothing the section, a *radiated series of clefts* may be made, and scions inserted in each.”—(*Enc.* 2029.)

692. *Crown-grafting*—sometimes termed “grafting in the rind or bark”—is another and very ready method of grafting upon large, uneven, old stocks and branches. It is practised somewhat later than the other methods—that is, from the end of March to the third week of April, because in that period the separation of the bark from the wood is more easily effected—a circumstance of primary importance in the present case. Suppose a deformed old espalier-tree, or a bad-bearing standard, is to be grafted in the bark, and that the object of the gardener is three-fold: first, to renew the head of his tree; second, to obtain a superior kind of fruit; and third, to introduce two or more varieties into the same stock;—he should proceed as follows:—Saw off the head of the tree horizontally, at a place where the bark appears to be as firm, even, and smooth as possible; and should such a place be found at only six inches above the level of the ground, it will—if the object be to obtain a new espalier—be all the better. Pare the surface of the wood and the edges of the bark smooth; then select the scions, either from those reserved for the purpose, or take them at once from the trees—for, as I have proved, the success may be alike.

With a sharp budding-knife, cut one side only of each scion (No. 1, figure 36, *s*,) flat, and a little sloping, and let the cut be an inch and a-half or two inches long; then make a sort of shoulder at the top of the cut, that the graft may rest upon the wood of the stock. In the next place, thrust the handle of the knife down, between the bark and wood of the stock, at the part marked *g*, 1; so as to raise the bark to the length of two inches, and thus permit the scion to pass between it and the wood. Some cottagers make a wedge of a piece of hard wood; this, which is termed a messenger, they cut to the length of about five inches, round it off on one side, make it quite flat on the other, and polish it on both; it is then a counterpart of a scion, but without a shoulder; and as a scion is about one-fourth of an inch in diameter, this instrument may be about one-third of an inch: the tool I employ is made of bone or ivory. If the bark do not yield readily, it is to be scored, or cut perpendicularly downward to the length required. The scion is then thrust in, between the bark and wood, with its cut side next to the wood, till the shoulder reach to, and rest upon the stock. A remark

that has sometimes been made during the performance of this work, is worthy of notice. If the scion “suck,” or draw in going down, making a kind of whistling sound, resembling that of an exhausting syringe, success is augured: and I have heard a grafter say, “*that will take; hear how it sucks!*” The philosophy is defective, but the observation is just. In fact, the air is expelled from between the two surfaces; and hence we may infer that atmospheric *pressure* is to be regarded—in point of time, at least—as one of the first agents of success.

Fig. 36.



Thus proceeding, two, three, or four grafts may be put upon the stock, at the places indicated by the lines \ / (No. 1, fig. 36.)

The grafting being finished, pass a smooth soft cord round the top of the stock, several times, so as to secure the scions; but do not draw so tight as to injure the bark; then clay the whole over in the form of a dome, that the rain may be effectually thrown off. “It is alleged,” says the *Encyclopædia*, “as a disadvantage attending this method in exposed situations, that the ingrafted shoots, for two or three years, are liable to be blown out of the stocks by violent winds; the only remedy for which is tying long rods to the body of the stock or branch, and tying up each scion and its shoots to one of the rods.”

Apples and pears are the fruits that are generally propagated by cleft and crown-grafting.

Repeated experiments have satisfied me that this method of grafting is applicable to the youngest stocks. For ~~apples~~ seedling Siberian crabs, two or three years old, are very proper: for pears, young plants of the *quince*, raised from seed, by suckers, or by layers; the *stocks* need not be more than a quarter of an inch over; and the *scions* only a little less. A graft carefully inserted within the rind, will, in a year or two, form a perfect junction with the

stock, and cover it so completely, as almost to obliterate any mark of the wounds, leaving the stem entire, and nearly without a cicatrix.

693. *Important Philosophical Remarks.*—Before I proceed further in descriptive directions, I must request the young gardener's particular attention to the following valuable observations of the late Sir Humphry Davy: they refer to the proper selection of grafts; and by evincing that the graft is not altered in its nature by the influence of the stock, they prove that the progressive developements of the scion are *purely its own*,—and, therefore, that sound healthy branches and shoots, growing on equally healthy trees, should invariably be chosen.

“In perennial trees, a new alburnum, and consequently, a *new system of vessels*, is annually produced, and the nutriment for the next year deposited in them; so that the new buds, like the plume of the seed, are supplied with a reservoir of matter essential to their first developement.

“The graft is only nourished by the sap of the tree to which it is transferred; its properties are not changed by it: *the leaves, blossoms, and fruits, are of the same kind as if it had vegetated upon its parent stock*. The only advantage to be gained in this way, is the affording to a graft from an old tree a more plentiful and healthy food than it could have procured in its natural state; it is rendered for a time more vigorous, and produces fairer blossoms and richer fruits. But it partakes not merely of the obvious properties, but likewise of the *infirmities and disposition to old age and decay of the tree whence it sprung*.

“This seems to be distinctly shown by the observations and experiments of Mr. Knight. He has, in a number of instances, transferred the young scions and healthy shoots from old-esteemed fruit-bearing trees, to young seedlings. They flourished for two or three years; but they soon became diseased and sickly, like their parent trees.

“It is from this cause that so many of the apples formerly celebrated for their taste, and their uses in the manufacture of cider, are gradually deteriorating, and many will soon disappear. The *red-streak* and the *moil*, so excellent in the beginning of the last century, are now in the ~~extremest~~ stage of their decay; and however carefully they are ingrafted, they merely tend to multiply a sickly and exhausted variety.

“The decay of the best variety of fruit-bearing trees which have been distributed through the country, by grafts, is a circumstance of great importance. *There is no mode of preserving them; and no*

resource, except that of raising new varieties by seed."—(*Agric. Lect.* pp. 228-9, &c.)

694. *Saddle-grafting* consists in cutting a stock of a medium size into a wedge-like form, and then adapting a graft to it, so that the latter shall ride upon, or be seated across the former; the two barks (on one of the sides at least) being brought into close contact with each other. The stock ought not to be much broader than the scion; and, therefore, when the operation is skilfully performed, it produces a neat and handsome graft. The *sub-variety* of this method of grafting described by Mr. Knight, is applicable to very slender stocks; but if the following directions, and the figure annexed, be carefully attended to, they may easily be made to apply to stocks of a larger size. Mr. Knight says:—

"As this mode has rarely or never been properly executed, it will be necessary that I describe the motion of the sap, as I conceive it to be, at the period when grafts are most advantageously inserted. The graft first begins its efforts to unite itself to the stock, just at the period when the formation of a new internal layer of bark commences in the spring; and the fluid which generates this layer of bark, and which also feeds the inserted graft, radiates in every direction from the vicinity of the *medulla*, to the external surface of the alburnum. The graft is of course most advantageously placed when it presents the largest surface to receive such fluid, and when the fluid itself is made to deviate least from its natural course. This takes place most efficiently, when a graft of nearly equal size with the stock is divided at its base (*g*), and made to stand astride the stock (*s*); and when the two divisions of the graft are pared extremely thin, at and near the lower extremities, so that they may be brought into close contact with the stock, (from which but a little bark or wood should be pared off,) by the ligature. I have adopted this mode chiefly in grafting cherry-trees, and I have rarely ever seen a graft fail, even where the wood has been so succulent and immature as to preclude every hope of success by any other mode."—(*Encyc. of Gard.*, 2034, from *Hort. Trans.* Vol. V., p. 147.)

A ligature of soft bass matting, or tape, should be passed round the whole intermediate space between *s* and *g*, fig. 37, excepting the bud *b* below the point *g*.

695. *Root-grafting*, as practised by Mr. Knight is thus described; 'Transplanting some pear-stocks from a seed-bed, of which the soil was soft and deep, I found that the first emitted roots of many of

Fig. 37.



them descended a foot or more, perpendicularly into the earth, before they divided into any lateral ramifications; and as I did not like to replant the young trees with such an inconvenient length of perpendicular root, I cut off about six inches from each. The amputated parts were then accurately fitted and bound, as in splice or whip-grafting, to scions of pear-trees, which were selected as nearly as possible, of the same size; and the roots, with their attached branches, were deposited in the ground as cuttings, so deep, that the whole of the root, and about an inch of the scion, were covered. The soil was then drawn up with the hoe on each side of the plants, which were placed in rows, so that one bud only of each graft was above the soil, and another just within it. These grafts succeeded perfectly well: and I have subsequently repeated the same experiment with equal success upon the apple, the plum, and the peach. In the greater part of these experiments, the roots were perfectly cleansed from mould by washing before they were fitted to the graft, and were then placed in wet moss, till a sufficient number were ready to be carried to the nursery; a common dibber only was employed in planting them: but the mould was washed into the holes with water to close it round the roots, and to supply the place of the clay used in other methods of grafting.”—(*Horts. Trans.* Vol. I., p. 239.)

“A variation of this mode consists in leaving that part of the tap-root not wanted with the removed tree undisturbed in the soil, and grafting on it there. Such root-grafts grow with uncommon vigour.” (*Encyc.* 2037.)

The ordinary mode of root-grafting is represented at No. 2, fig. 36;—“It is performed in nurseries, on part of the roots of removed trees, when the proper stocks are scarce; and in which case, the root of the white thorn has been resorted to as a stock, both for the apple and pear. In general, however, a piece of the root of the tree of the *same genus* is selected, well furnished with fibres, and a scion placed on it, in any of the ordinary ways for small stocks. Thus united, they are planted so deep as to cover the ball of clay, and leave only a few eyes of the scion above ground.”—(*Idem*, 2036.)

696. *Preparation of the scions* in general.—These are usually collected several weeks before the season for grafting arrives—that is in January, or early in February. See the article *Grafting*, No. 38, on the *Propagation* of the apple-tree, p. 45. It is said that “the sap of the stock should be in brisk motion at the time of grafting; but by that time the buds of the scion, if left on the parent tree, would be equally advanced; whereas, the scion being gathered early, the buds are kept back, and ready only to swell out when placed on the stock.”

This mode of reasoning appears to me to be founded upon the old theory of the exclusive agency of the ascending sap; and it implies that the scion is in a dry and thirsty condition, eager to imbibe the ascending fluid. The electrical theory considers the flow of the sap as an operation of *induction*, that the buds of the twigs are the immediate instruments by which that induction operates; and therefore, that just in proportion to the identity of condition subsisting between the scion and the stock, will be the speed and certainty with which the union between the two is effected. What experience may finally determine, I know not, but am prepared to say, that I have instances now before me—all of successful graftings—wherein the scions taken off the tree at the moment of “grafting in the crown,” were more speedily knitted to the stock than others that had been cut off and kept in mould for some weeks before they were wanted.

697. *Future treatment of grafts.*—A month will often suffice to determine the success or failure of the grafting. If the buds swell, it may be presumed that the union is taking place; but I have observed in crown-grafting, that a set of apple scions which I had inserted into a stock, varied in their appearance, from week to week, to such a degree, that I could not feel certain of success till the period of the July shoot; they then started off at once, and some of them grew to the length of fourteen or sixteen inches. The clay may be removed from all grafts about the middle of July, and the ligatures should then also be relaxed. If the top of the stock, in whip-grafting, have not been removed, it may then be cut off diagonally; and if this be neatly done, the granulations from the bark will speedily cover the wound. To prevent accidents from the force of the winds, stakes ought, in most cases, to be placed in the ground, to which the young shoots can be fastened. A bandage of wet moss is recommended to be kept over the graft “to preserve moisture, encourage the expansion of the parts, and complete filling up the wound.”

698. *Choice of Stocks.*—“If, as in the case of standard cherries, the stock is intended to form the stem, then it must be suffered to grow six or seven feet high, and be afterwards headed down to five or six feet for the reception of the scion. The French and Americans graft and bud their stocks much higher than is practised in Britain, which some believe contributes to the durability of the tree.

“J. Wilmot is of opinion, that, by the opposite practice, the whole of the wild or proper stock, in garden-grounds where the soil is continually raised by manure, becomes buried in the soil, and

reduced to a mere root; and then, he says, the tree begins to decline in vigour, and soon decays and dies.”—(*Encyc. of Gard.*, 2040, from *Hort. Trans.* Vol. I. p. 215.)

699. *Grafting clay, and substitutes for.*—The clay is prepared with three parts of blue or yellow clay, or brick earth; one part of fresh horse-dung, free from litter, and a small portion of soft, cut hay, or hemp. These are to be well mixed together, and beaten on a stone pavement, with a mallet or batting stick, adding a small quantity of water from time to time, till the mass becomes of a tacky, firm texture, yet sufficiently tractable to be moulded by the hands into any form. The beating is directed to be repeated twice or thrice daily, for three or four days. A little common salt,—that is, about a table-spoonful to half a peck of clay, will tend to preserve the moisture; but much salt might be injurious to the graft. The French often substitute cow-dung for that of the horse. Wax and rosin, wax and pitch, tallow and rosin, or pitch, melted together, have been applied in a melted, but not very hot state, either alone or on strips of brown paper, as substitutes for clay. I myself have employed melted pitch to crown-grafts, and have found it answer; but what I would recommend is, the usual claying; and then, after the mass have become dry, and any adventitious cracks been closed up with clay, that it be painted all over with coal-tar. This should be applied in the evening, or when the sun does not shine; and as soon as the first coat have become dry, a second should be laid on, observing the same precautions.

### INARCHING.

700. *Inarching, or grafting by approach*, is a process wherein a young shoot is bent and slit up; and the heel that is intended to produce granulations and vascular fibres, is inserted into the wood, or between the bark and wood of another tree, instead of being placed as a *layer* in the soil. *The Encyclopædia of Gardening* describes this process as an operation closely resembling that of layering (see the description, No. 619), and considers that it evidently depends upon the same general principles, and “all the difference is, that the granulated matter which exudes between the bark and the wood of the talus or heel, instead of throwing out fibres, unites with the wood of the stock or plant to which it is attached, forming a solid ligneous union, which, when the layer or shoot is separated from the mother plant, supplies it with nourishment, as the fibres do the common layer.”

*There is a mystery attending all the phenomena of vegetable*

developement, which the human mind has been unable to solve: with Mr. Main, I incline to believe that a living, vital membrane or material, organized, or organizable substance, exists in every plant, which is *fed*—not created—by the nutritive juices absorbed, or attracted, from the soil and atmosphere: under this view of vegetable increase the *stock* receives, and conveys the raw sap; and the *scion* furnishes the matured fluid prepared in the leaves. But both stock and scions contain the rudiments of parts to be revealed in succession, and these are brought to light, and nourished by the nutritive fluids: hence, as each contains the principle of increase, they both retain their own specific character, and perfect their own peculiar developements.

Inarching is almost an infallible mode of propagation with plants that cannot otherwise be excited to protrude roots. Professor Thouin has enumerated thirty-seven varieties of inarching, all of them, however, being reducible to two, namely, *crown inarching*, wherein the head of the stock is cut off at the time of operating; and *side inarching*, wherein the head is retained for a time. The latter is thought to be more suitable to delicate and tender trees or shrubs, and also when blank spaces among the branches are to be filled up.

701. *Method of performance, and time.*—The operation is usually performed in the spring; and by it, orange-trees, camellias, and other valuable and ornamental shrubs are propagated. It is also successfully applied to herbaceous vegetables with solid stalks. “The vine of the cucumber may,” it is asserted, “be inarched on that of the gourd, the love-apple, or the potatoe, &c.” Propinquity or relationship is, however, indispensable, as in other cases of grafting.

702. *Inarching a branch or shoot upon its own tree.*—By attending to a method of operating practised by Mr. Knight, and recorded by himself in his own masterly manner, the reader may be enabled to form a very sufficient idea of the more ordinary modes of inarching; for he will only have to reflect upon Mr. Knight’s philosophical directions, and then to apply them to the example of a tree or shrub, near which another plant in a pot is so placed, that a branch from the former may be bent and arched, till the bark of one of its sides can be brought into close contact, to the length of an inch or two, with the bark of the latter—that is, with the bark of the tree in the pot into which it is intended to be layered or ingrafted. Mr. Knight says:—

“In the last season (1812) a *peach-tree* in my garden, of which I was very anxious to see the fruit, had lost, by the severity of the

weather, all its blossoms except two, which grew upon leafless branches. I was very desirous to preserve these, as well as to ascertain the cause why the *peach* and *nectarine* under such circumstances fail to acquire maturity. The most probable cause, according to my hypothesis, appeared to be the want of returning sap, which the leaves (if existing) would have afforded, and the consequent morbid state of the branch; I therefore endeavoured to derive the necessary portion of returning sap from another source. To obtain this object, the points of the branches which bore blossoms, were brought into contact with other branches of the same age that bore leaves; and a part of their bark, extending in length about four times their diameters, was pared off immediately above the fruit. Similar wounds were then made upon the other branches, with which these were brought into contact; and the wounded surfaces were closely fitted, and tightly bound together. An union took place; and the fruit, apparently in consequence of it, acquired the highest state of maturity and perfection."

703. The *common operation* is thus described.—“Having made one of the most convenient branches or shoots approach the stock, mark on the body of the shoot the part where it will most easily join the stock; and in that part of each shoot pare away the bark and part of the wood two or three inches in length; and in the same manner pare the stock in the proper place for the junction of the shoot; next make a slit upwards in that part of the branch or shoot, as in layering, so as to form a heel, but more of a tongue-shape than in layering, and make a slit downward in the stock to admit it. Let the parts be then joined, slipping the tongue of the shoot into the slit of the stock, making both join in an exact manner, and tie them closely together with bass. Cover the whole afterwards with a due quantity of tempered or grafting clay or moss.”—(*Encyc. of Gard.* 2009.)

704. *The union between the layer and the stock* may be effected in four or five months; but in some cases it may be protracted for one or two years. Whenever it is found to be complete, remove the clay and ligature; hold the layer tenderly, but with a firm hand; and then separate it from the mother plant by a sloping cut made downward with a very sharp knife close to the stock; and at the same time cut off the head of the stock, if it were not removed at the period of inarching. The separation being effected, clean the stock from insects, or dirt of any kind. Be very gentle in this operation: but wash it effectually with a sponge, or soft brush, and water, and then it might not be amiss to apply a little of the clear fluid that floats upon the sulphuret of lime, described at No. 49.

After washing, a new ligature and fresh clay should be put on, and suffered to remain for a few weeks.

## BUDDING.

705. *The operation of budding* consists in transferring a *germ* or bud from a young shoot (generally the spring shoot of the current year), with a portion of the surrounding bark, to the branch of another tree, and there placing it in close contact with the *alburnum* of that tree; and with one or more of the edges of that portion of bark in exact union with one edge, or all the edges of the bark of the tree to which it is transferred.

706. *The science of budding* may be rendered familiar by a reference to what has been already said on the origin of the divergent layers at No. 328, on that of the liber and alburnum at No. 404, and by comparing it with the following quotation from KEITH'S *Physiological Botany*.

Du-Hamel, whose "experiments are an anticipation of almost everything that has been done by the most distinguished of our modern phytologists," undertook an inquiry in order to ascertain the origin of the new annual layer of wood: "his first experiment was that of a graft, *par l'ecusson*" (an escutcheon, or shield), "which is done by means of *detaching a portion of bark* from the trunk of a tree, and *supplying its place exactly* by means of a portion of bark detached from the trunk of another tree *that shall contain a bud*. In this way he grafted the peach on the prune-tree, because the appearance of the wood which they respectively form is so very different, that it could easily be ascertained whether the new layer was produced from the stock or from the graft. Accordingly, at the end of four or five months after the time of grafting, the tree was cut down, and as the season of the flowing of the sap was past, a portion of the trunk, including the graft, was now boiled, to make it part more easily with its bark, in the stripping off of which there was found to be formed under the graft a thin plate of the wood of the peach united to the prune by its sides, but not by its inner surface, although it had been applied to the stock as closely as possible: hence Du-Hamel concluded, that the new layer of wood is formed from the bark, and not from the wood of the preceding year."—(Vol. II. p. 218.)

707. *The success of budding* depends upon the preservation of what is called the *root* of the bud: this root may, I think, be traced to a certain white line, or track of parenchymatous matter that is observed to traverse the ligneous layers, on cutting a twig or branch

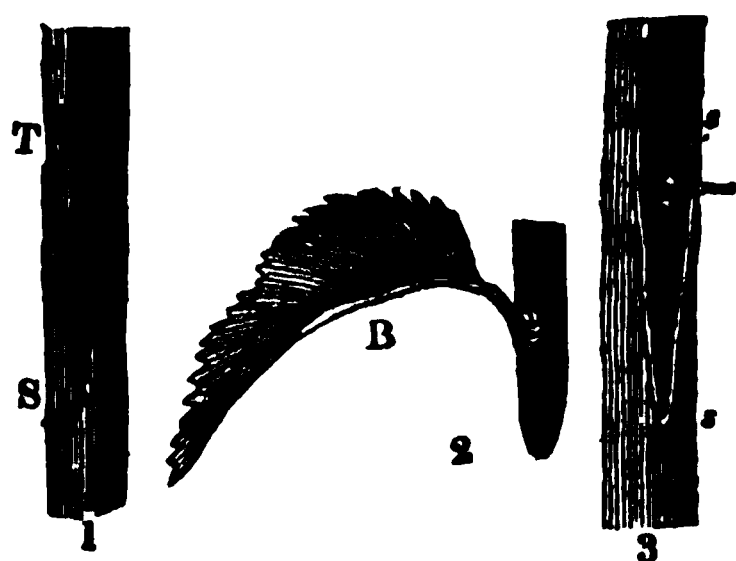
across, at the spot whence a bud protrudes. This fact, which was referred to at No. 243, when viewed in connexion with the phenomena of the extinction of the *pith* in full grown and old stems, satisfies me, notwithstanding all that has been said to the contrary, that the pith or *medulla* is the original magazine of nutritive matter to all the buds; and that the buds contain and carry onwards the matter of the pith, the natural termination of the tree's life being coincident with the final developement of the buds, and the total exhaustion of the medullary matter. I could, (and may, at some future period,) adduce several interesting facts in support of this opinion, but shall now confine myself to those contained in the following quotation:—

“No determinate period is fixed for the protrusion of the germ into a bud; but at whatever time this may happen, its course is *traceable from the medullary sheath to the surface on which it appears*, by a pale stream of parenchymatous matter traversing each annual, concentric, ligneous layer. But this parenchymatous track only marks the advancement of the vital speck or germ to the surface of each annual belt of wood; and is altogether useless as far as regards the germ, except in the belt, on the surface of which it is seated, with the life of which, indeed, *its vitality is intimately connected*. Destroy this, and the germ becomes extinct; augment its vital energy, and the germ is unfolded into a perfect bud and branch; but leave things as they are, and the germ will advance to the surface of the next year's belt of wood, and so on progressively, until it be ultimately unfolded, or perish with the destruction of the tree.”—(*Treatise on Veg. Phys.*, p. 19.)

708. *Season of Budding and choice of Buds.*—The season is usually from the latter end of July to the latter end of August. The plumpness of the buds, and the readiness with which the bark may be detached from the wood, determine the proper period for the performance of the work. Fine plump buds in the *middle* of a young shoot of the present year's growth, are generally preferred, as they are found to be less inclined to run into wood than the buds at the extremity of the shoot, and not so apt to remain dormant as those at the lower end. Either a cloudy day should be chosen for the work of budding, or it ought to be deferred till the evening, that the influence of the sun may not, in the first instance, prevent adhesion of the parts. The materials required for the operation are, a sharp budding-knife with a polished ivory handle; several strong flat and soft strings of bass matting, or tape; a basin of water, and a handful of moistened moss: all these should be in readiness, as the work ought to be performed with some despatch.

709. *Varieties of Budding*.—Professor Thouin enumerates twenty-three species and varieties; but the following directions will be limited to three only. The first is that termed T budding, a variety of which is sometimes practised, wherein the incision is made in the form of a  $\perp$  reversed. The second is *scalope* budding, which may be performed in the spring, or at times when the bark will not separate freely from the wood. The third is a method that combines the two former, and may, with more propriety than either, be termed *shield* budding.

Fig. 38.



710. T budding is thus described in the *Encyclopædia of Gardening*:—"Fix on a smooth part on the side of the stock, rather from than towards the sun, and of a height depending, as in grafting, on whether dwarf, half, or whole standard trees are desired; then, with the budding-knife, make a horizontal cut across the rind, quite through to the firm wood; from the middle of this traverse cut, make a slit downward (T, No. 1, figure 38) perpendicularly, an inch or more long, going quite through to the wood. This done, proceed with all expedition to take off a bud; holding the cutting or scion in one hand, with the thickest end outward, and with the knife in the other hand, enter it about half an inch or more below a bud, cutting near half way into the wood of the shoot, continuing it with one clean slanting cut, about half-an-inch or more above the bud, so deep as to take off part of the wood along with it, the whole about an inch and a-half long (B, No. 2); then, directly with the thumb and finger, or point of the knife, slip off the woody part remaining to the bud; which done, observe *whether the eye or gem of the bud* remains perfect; if not, and a little hole appears in that part, it is improper, or as the gardeners express it, the bud has *lost its root*, and another must be prepared. This done, placing the back of the bud or shield between your lips, expeditiously with the flat haft of the knife, separate the bark of the stock on each side of the

perpendicular cut clear to the wood" (see the dark space in No. 1) "for the admission of the bud, which directly slip down, close between the wood and bark to the bottom of the slit *s*. The next operation is to cut off the top part of the shield *B* even with the horizontal first-made cut, in order to let it completely into its place, and to *join exactly the upper edge* of the shield with the transverse cut, that the *descending sap may immediately enter the bark of the shield*, and protrude granulated matter between it and the wood, so as to effect a living union." (See the bud inserted, and fitted into the stock at figure 3, 38.) "The parts" (between *s, s*), "are now to be immediately bound round with a ligament of fresh bass previously soaked in water, to render it pliable and tough, beginning a little below the bottom of the perpendicular slit, proceeding upward closely round every part except just over the eye of the bud, and continue it a little above the horizontal cut, not too tight, but just sufficient to keep the whole close, and exclude the air, sun and wet."—(*Encyclopædia*, No. 2057.)

711. *Remarks*.—The foregoing directions are clear and explicit as far as they go; but I venture to say that, in nine cases out of ten, the domestic gardener, in following them, would fail to produce a living union between the bud and stock; *for the root would be lost*, and a little hollow, or indentation, discerned close behind the centre of its internal base. In such a case it must be impossible to bring the parts immediately behind the bud into close contact with the alburnum of the stock, by any force that the ligature could produce. *Budding* differs from common grafting, inasmuch as in the latter, the buds of the scion lie safely embedded in their own native matrix, and the junction of the edges of the two barks suffices to effect the desired union; but in the former, the bud, in order to produce its developements, must rest upon an appropriate medium; and if its life have been previously identified with that of the ligneous matter in which it lay embedded, it cannot continue to live unless it be placed in absolute contiguity with some congenial substance, resembling that from which it has been severed. Now, such may, I think, be found in the divergent layers (*radii medullares*), for their substance appears to be parenchymatous, and they are known to extend to the alburnum and liber.—(See Nos. 314 and 326.) But, to bring the base of the bud into contact with any part of the alburnum, the point of the knife ought to be passed carefully between the heel of the bud and the piece of wood within the shield, so as to cut it through, and bring away the purely-woody part only, leaving the eye, or root, entire, and the surface, within the shield,

perfectly level throughout\*. This being adroitly done, every part might be made to touch the inner wood of the stock, and the incision being speedily and tightly bound up, and then enveloped for two or three days in moistened moss, the union could scarcely fail to take place, and the gardener's dexterity would be rewarded with deserved success.

In the figure (38) B, *the leaf of the bud* is left entire; and I formerly entertained the opinion that the leaf might promote the junction and vitality of the bud; but experience has proved that it rather acts, directly, as an organ of *transpiration*, and tends to dry the bud, in rose-budding particularly. Nurserymen cut off the leaf and a portion of its stalk, at all times, and they are the pupils of experimental facts.

712. *Scalope-budding* "consists in paring a thin tongue-shaped section of bark from the side of the stock; and in taking a similar section from the shoot of buds, in neither case removing the wood. The section or shield containing the bud, is then laid on the corresponding scalope in the stock; its upper edge exactly fitted as in shield" (T) "budding, and at least one of its edges as in whip-grafting. After this, it is to be tied in the usual way. The advantages of this mode are, that it can be performed when the wood and bark do not separate freely; on trees having very stiff, thick, suberose" (corky) "barks, and at any season of the year. Its disadvantages are, that it requires longer time to perform the operation, and is less certain of success. The French gardeners often bud their roses in this manner in spring; and if they fail, they have a second chance in July by using the common mode."—(*Encyc. of Gard.*, 2059.)

713. *Shield-budding proper*, or grafting *par l'Ecusson*. Du-Hamel's experiment has been described at No. 706; it forms the basis of the method now to be proposed. In order to present a broader surface of bark to the alburnous vessels of the stock, and also to bring the four edges of the transferred shield of bark into close contact with those of the stock, I propose to select the finest shoots of the apricot, peach, and nectarine, furnished with plump

\* It would be still better to cut the bud and shield so thin in the first instance, as to bring away the merest shaving of wood with the bark; there would then be no necessity to remove it. This can be readily effected by a thin-bladed and very sharp knife, and the success of the operation would never be rendered doubtful by the atom of wood (which consists of little else than the alburnous vessels) remaining. I have seen the operation thus performed by cottagers upon young cherry-trees, without any hesitation, it being their constant practice, proved and sanctioned by the experience of their whole lives.

well-formed buds, and to remove these one by one in the following manner:—Make two annular incisions in the bark, each at the distance of three-fourths of an inch, one above, and the other below the bud, and then cut a slit downward, from ring to ring, on the side of the shoot opposite to the bud. Raise the bark on each side of this cut, so as to detach the whole belt, till it approach the seat of the bud; and now pass the point of the knife under the bud so as to cut off that small prominent process of the wood which includes the eye of the bud. Here then is an entire ring of bark with a perfect bud upon it. Lay this piece upon the bark of the stock, at the precise spot where the bud is to be inserted; hold it firmly down, and with an extremely fine and sharp-pointed knife, cut through the barks, both the bark of the shield, and that of the stock under it; and cut so deeply, that the latter shall be penetrated quite down to the alburnum. The shield, while thus held, should be cut into the form of an oblong, from a quarter to half an inch wide, and an inch and a-quarter long; which done, take off the shield, detach the piece of bark from the stock as quickly as possible, and instantly supply its place with the shield containing the bud. If the operation have been dexterously performed, the wound will thus be effectually closed and covered over.

I acknowledge that this method of budding will require time, and also much nicety and precision; but as a little practice—in this instance, as in most others—will “make perfect,” I contend that the method contains every requisite to ensure a successful result; for, not only is a broad surface of active young *liber* presented to a corresponding surface of the *alburnum* of the stock, but the eight edges of the two *libers* are brought into close contiguity. If the shield be depressed a little below the edges of the bark of the stock, in consequence of that bark being thicker than the bark of the shield, the outer edges may be cautiously pressed down with the two thumbs, and a compress of moistened moss laid over them. The ligature is next to be applied; and this, I think, ought not to be of bass, but of soft strong tape. Tie it first round the stock, half an inch below the inferior cut; then, wind both ends, crossing each other, round and round; drawing firmly, yet cautiously at each turn, till the ligature reach the lower base of the bud; avoid this, and pass the next turn above the *apex*, but close to the superior base of the bud; then proceed as before, and finally tie the ligature at half an inch above the upper cut in the stock.

I think that this method will ensure most of the advantages attendant upon scalope-budding, without any of its disadvantages; and that it may be practised on wood of any age, provided the bark

be in a state to be readily detached; but I would decidedly prefer a healthy young stock and scion, which would receive and furnish a bud and shield of the dimensions that I have named; the comparative ages of the two would be a matter of minor importance. The *Encyclopædia* says, when speaking of budding generally, that it may be performed on shoots of the same year's growth, also on stems of several years' growth; and in such, by inserting a number of buds, a complete tree may be formed at once.

714. *Future Treatment of the Buds.*—"In three weeks, all those which have succeeded will be firmly united with the stock, and the parts being somewhat swelled in most species, the bandage must be loosened, and in a week or two afterwards, be finally removed. The shield and bud now swell in common with the other parts of the stock; and nothing more requires to be done till spring, when, just before the rising of the sap, they are to be headed down close to the bud, by an oblique cut, terminating about an-eighth, or a-quarter of an inch above the shield." When the bud pushes, it may be needful, as in grafting, to place a stake in the soil, or to attach a stick to the stock on the side opposite to the bud, to which the young advancing shoot may be tied.

## PART II.

### OPERATIONS OF PRUNING AND TRAINING.

715. The operations of pruning and training are closely united; they go hand in hand with one another; for when a tree is trained, it is, or has been pruned, in order to prepare it for the situation which it is to occupy. But though the two operations are but as one in respect to time, they each effect different objects, and are followed by different results; by the one, we curtail the bulk and extent of a tree; by the other, we regulate its position.

716. *The objects of pruning* are stated in the *Encyc. of Gardening*, to be the "promoting growth and bulk, lessening bulk, modifying form, promoting the formation of blossom buds, enlarging fruit, adjusting the stem and branches to the roots, renewal of decayed parts of trees, and removal or cure of diseases." Pruning is doubtless productive of very important consequences, but these, I think, have, in many cases, been misunderstood; for it has generally been supposed, that pruning promotes growth in trees. That this is an error, may, I conceive, be readily demonstrated; for as every bud and twig has a vital function to perform, it follows, that as far as regards

the *vital principle* of the tree, we do anything but strengthen it, by lopping and cutting with the bill and pruning-knife. By pruning and training we indeed *educate* the tree, and make it subservient to our will; we place it in an unnatural position, spread it abroad, expand and depress its boughs and branches; nay, we produce an appearance of growth and expansion of parts by the operations of the knife; for we compel nature to make attempts at self-preservation by a precocious developement of those buds, which, for a time, or even a long period of years, might otherwise remain dormant in the stems; but all these are processes of exhaustion, and not of energy. The consequences prove this to be the fact, because, *fertility* is the invariable result; and fruit-bearing is the constant attendant upon, as well as the certain effect of, whatever tends to check vigorous or luxuriant growth. We gain fruit, but abate the *vis vitæ*; we induce precocity, but shorten life; hence, I consider loppings and prunings of every kind to be injurious, where duration of life, and bulk of timber are the objects. Let us not mislead our judgments, but rather acknowledge facts; a tree is not benefited by prunings, but its *fertility*—the final object of its being—is, doubtless, accelerated; and, therefore, whenever we prune or disbud fruit-bearing trees, we do it expressly to obtain fruit-buds within certain prescribed limits; and we gain our ends: but let us not be so unphilosophical as to suppose that we thereby improve the strength and vitality of the tree.

Keeping these principles of the truth in view, I proceed to adduce the following excellent directions by Mr. Knight.

717. *Pruning necessary to form standard trees.*—For the apple, and all standard trees, he advises, “that the points of the external branches should be everywhere rendered thin and pervious to the light, so that the internal parts of the tree may not be wholly shaded by the external parts; the light should penetrate deeply into the tree on every side, but not anywhere through it. When the pruner has judiciously executed his work, every part of the tree, internal as well as external, will be productive of fruit; and the internal part, in unfavourable seasons, will rather receive protection than injury from the external. A tree thus pruned, will not only produce much more fruit, but will also be able to support a much heavier load of it, without danger of being broken; for any given weight will depress the branch, not simply in proportion to its quantity, but in the compound proportion of its quantity, and of its horizontal distance from the point of suspension, by a mode of action similar to that of the weight on the beam of a steelyard; and hence a hundred and fifty pounds, suspended at one foot distance from the trunk, will depress

the branch which supports it no more than ten pounds at fifteen feet would do. Every tree will, therefore, support a larger weight of fruit without danger of being broken, in proportion as the parts of such weight are made to approach nearer to its centre."

718. "*In pruning to form dwarf-standard trees (basse-tiges, Fr.)* the plants being furnished with shoots of one year's growth, are to be cut down to three or four buds, which buds will throw out other shoots the following year, to form the bush or dwarf. If these buds throw out during the second year, more than can grow the third year, without crossing or intermixing with each other, then the superfluous shoots must be cut off; but if too few to form a head regularly balanced, or projecting equally beyond the stem on all sides, then one or more of the shoots in the deficient part must be cut down to three or four eyes, as before, to fill up, by shoots of the third year, the vacancies of the bush. In this way must the tree be treated year after year, cutting away all cross-placed branches and crowded shoots, till at last it shall have formed a head or bush, globular, oblong, or of any other shape, according to its nature; and with this property common to every form, that all the shoots be so far distant from each other as not to exclude the sun's rays, air, or rain, from the blossoms or fruit."—(*Encyc. of Gard.*, No. 2116—17.)

#### TRAINING WALL AND ESPALIER-TREES.

719. *Horizontal training.*—This method of training is peculiarly applicable to trees that bear their fruit upon spurs—such are apples, pears, plums, cherries, and mulberries. For *general principles* I refer the reader to the preliminary axioms in pruning, laid down at No. 85, of the culture of the *Peach-tree*; to the remarks on Harrison's method of pruning, at No. 224; and to the abstract of that writer's excellent directions for the management of the *Plum-tree* contained in the paragraphs No. 225 to 235, inclusive. I know not any author that appears to be so completely master of his subject as Mr. Harrison: I therefore shall adhere to his directions in drawing out the annexed sketch of the treatment of the apple-tree. This, with the copious extract above alluded to, will perhaps afford a sufficient idea of that mode of horizontal training which is so eminently successful in promoting the fertility of spur-bearing trees. Harrison's directions, apply, it is true, to a tree trained against a twelve-foot wall, and so far they require some degree of modification to adapt them to espalier training; but this will be confined chiefly to the operations of the first year; for whereas Harrison gains six branches during the first summer, it will, in the case of espaliers, suffice to

procure four branches. The subsequent directions may also be limited to five or six years, in which period the tree will in all likelihood be completely formed.

720. *Preliminary operations.*—The work of training the *apple-tree* horizontally should commence with a seedling, raised by the gardener himself, or by one of his children—for the education of a boy of ten years old ought to embrace such pursuits. Suppose the seeds of some hardy apple to be sowed in March—the young trees to be transplanted into nursery rows, twelve inches apart, in the autumn of the same year, or in March of the following year. In order to give a definite form and reality to the following directions, suppose that, in the spring of 1840, these seedlings are cut down to two or three buds above the surface, just before those buds begin to swell. At this period they are two years old; and in the course of the summer they make straight, well-grown stems; and early in the spring of the next—their third year—they are to be transplanted to another bed, there to remain till the time of grafting, namely, the following March, when they will be somewhat short of four years old.

Trees so treated—after the grafts shall have made their first year's growth—are called *maiden trees*, and such Harrison directs to be chosen: for, he says, “always plant a maiden tree, and one that has only one upright stem.” One of these young trees is selected, and now, at the age of four and a-half or five years, it is transplanted to the spot where it is to remain, and become a wall or espalier-tree, extending its branches horizontally, to the length of twelve or even fifteen feet on each side of the central main stem.

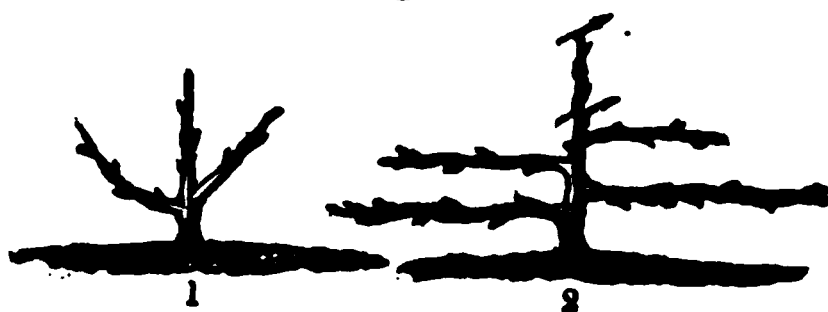
The author commences his directions with the first year's winter pruning. What follows, though of necessity an abbreviation, is in substance altogether unaltered.

721. *First year—Winter pruning.*—The tree is first to be headed down just before it begins to push; the time the same as that directed for the plum-tree, 227; and care must be taken to have a sharp knife, that the cut be as smooth as possible. This cut—as in the case of all prunings—is directed to be made sloping, in the same direction as the bud, and half an inch above it. One foot is to be placed close to the bole, to prevent the tree from being drawn up by the force made use of. It must be cut so that (for a wall) seven buds remain upon the stem that is left. If the tree be a weak one, let three eyes only remain.

*Summer pruning.*—When all the buds have pushed, and attained three inches in length, two of them (the third and fourth) must be rubbed off. Of the remaining five—or three, as it may be—one must be trained straight up, for a leader, and the others horizontally

along the wall or trellis, one or two on each side of the stem, and if two, at nine inches apart. When the leading upright shoot has attained about fifteen inches in length, as it will by the end of June, or early in July, let the end be pinched off, so as to leave it about eleven inches long. This stopping will cause some shoots to be produced from the upper part of the lead which was stopped; and two of these shoots are to be trained horizontally, nine inches above the two previous shoots, and the uppermost straight up the wall, or rail.

Fig. 39.



722. *Second year—Winter pruning.*—About the middle or latter end of November, the leading shoot is to be shortened to ten inches above the place where it was last stopped. (See figure 39, where No. 1 exhibits the first formed shoots, after the heading-down; and No. 2, the tree after the second pruning.) The tree will now be furnished with four or six horizontal shoots, and an upright leader extending about twelve inches above the uppermost side shoot. These side shoots or branches must never be shortened, but left at their entire length.

*Summer Pruning.*—When the buds upon the leading shoot have pushed, rub off all but the three uppermost; train two of them horizontally, right and left, and the topmost as a lead to the main stem.

The buds upon the wood of last year will this summer generally make some short, robust, fruitful buds: these are to be encouraged; but if wood-shoots arise instead of fruit-buds, they must be allowed to grow till June: when, the wood having attained a degree of hardness, they are to be cut down to two inches; and if they push again, and produce one or more secondary shoots, they must be cut to about two inches from where they last pushed. If more than one shoot was produced after the first shortening, and a bud or two be well swelled at the origin, all the shoots must be left and shortened, but if such bud does not swell, all the shoots must be cut clean away to one, which may be shortened as directed.

723. *Third year—Winter Pruning.*—All fruitful buds to be retained. If two have been formed at the lower part of any of the shoots shortened as above, the shoots must now be cut off about a quarter

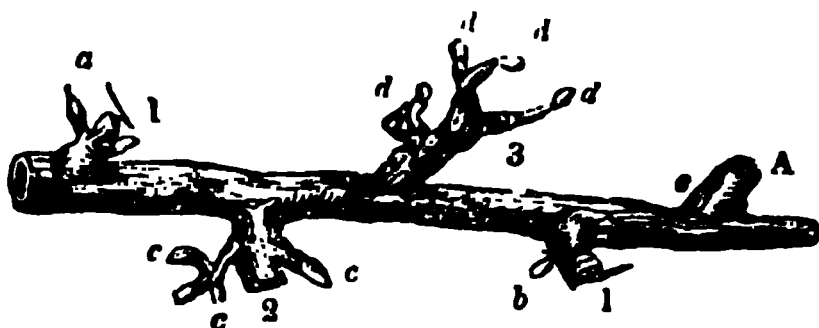
of an inch above the uppermost bud. If growing buds only have been produced, then the shoot is to be cut down, so as to leave one bud only.

*Summer Pruning.*—The fruitful buds will be productive; when the fruit has swelled a little, a shoot will generally proceed from the stem of the spur just underneath the fruit: such may be allowed to grow eight or ten inches long, and must then be shortened back so low as to leave three eyes upon it. By this means, two or more fruitful buds will generally be produced at the bottom of the shoot, or otherwise from the lower part of the spur.

Thus the work proceeds at the two periods of regulation. At the *summer prunings*, spurs are prepared by shortening the young shoots; and at the *winter prunings*, these are further shortened, or if redundant, are cut altogether out.

724. *The Sixth—Winter Pruning.*—The period of the progressive regulation of the spurs, according to Harrison's method, now commences; of which operation some idea may be formed by reference to the annexed figure, 40.

Fig. 40.



All the spurs formed on the first year's wood (No. 1, 1), are supposed to be furnished at this time with four or five fruitful buds: they are now then to be cut down to the marks *a*, *b'*, above the lowest bud on each.

Every spur, as at No. 2, is to have three fruit-buds (*c, c, c*); and every spur, as at No. 3, is to have four buds (*d, d, d, d*).

“When a spur, No. 1, is destitute of either a fruitful or growing bud towards the lower part of it, such a spur must be cut down so low, as only to leave about half an inch remaining; as at *a—A*, there is generally an eye or embryo of a bud situate near the origin of the spur *A*; from this a shoot or a fruitful bud will be produced the ensuing summer, and thus a supply will be obtained for that cut away.”

“In the *seventh* year, the spurs at No. 3 will be cut down to one principal bud, and so on in succession till the *tenth* year, when the spurs at No. 1 will be cut down again. Thus, “it will be observed, that the spur No. 1 has been cut down twice,—the first time in the

sixth year, and the second in the tenth,—thus having borne fruit four years.”—“This regular system of cutting down and treating spurs, must be practised upon all other spurs as is here directed. Thus the next year (eleventh), the spur No. 3 must be cut down, and then—being the second from the present period (twelfth)—the spurs No. 1 (cut down as at No. 1, *a*) will require to be cut down again.”

725. *General Remarks.*—For *espaliers*, as well as for wall-trees, the branches should be trained nine inches apart; but as a wall twelve feet in height will require seven years to fill it, even admitting that two branches on each side of the stem be gained every year, it is evident that an espalier rail, five feet high, will be surmounted by the period of the *fourth* winter's pruning. The gardener should bear this in mind, and also that the training of the central leading shoot is to be discontinued when the tree arrives within a few inches either of the coping of the wall, or of the top rail of the trellis. In other respects, “the plan of forming the head of the tree must be pursued that is laid down for wall-trees.” The horizontal branches are never to be shortened, until they extend as far as can be admitted; then they are to be pruned in the winter to two or three buds from where they pushed the spring before. “When this method has been adopted as long a time as it possibly can be done, the end of the branch must be cut back half a yard or two feet, to a well-situated shoot, for a supply.”

*Regulating the Spurs on Espaliers.*—“Whereas in wall-trees only four are left, espaliers will admit of the full number having a more free circulation of air than wall-trees;” and, therefore, “when a spur has five fruitful buds upon it, they may all be permitted to remain.”—(See *Treatise on Fruit-Trees*, Ch. XX.)

Such are the outlines of a practice which is, upon the whole, judicious. A modification of the summer regulation of the shoots, however, might be adopted. I think it will be apparent to every practical pruner that, if the shoots from the horizontal branches be cut back to three buds, when they have attained eight or ten inches growth, the wood will be very succulent and vigorous; that every eye will break into a wood shoot, and thus require a second cutting back. To gain *fruitful* buds, every shoot should be left till the July, or second shoot of the season, be ready to start. At that period, the *spring wood* will be ripe and firm, and then the shoot should be snapt or broken, but not detached, so as to leave eight or ten eyes above the base of the shoot at its origin in the spur or horizontal branch. This process will check the principle of growth, and the vital fluids will be forced into the lowest buds, one or two of which will gene-

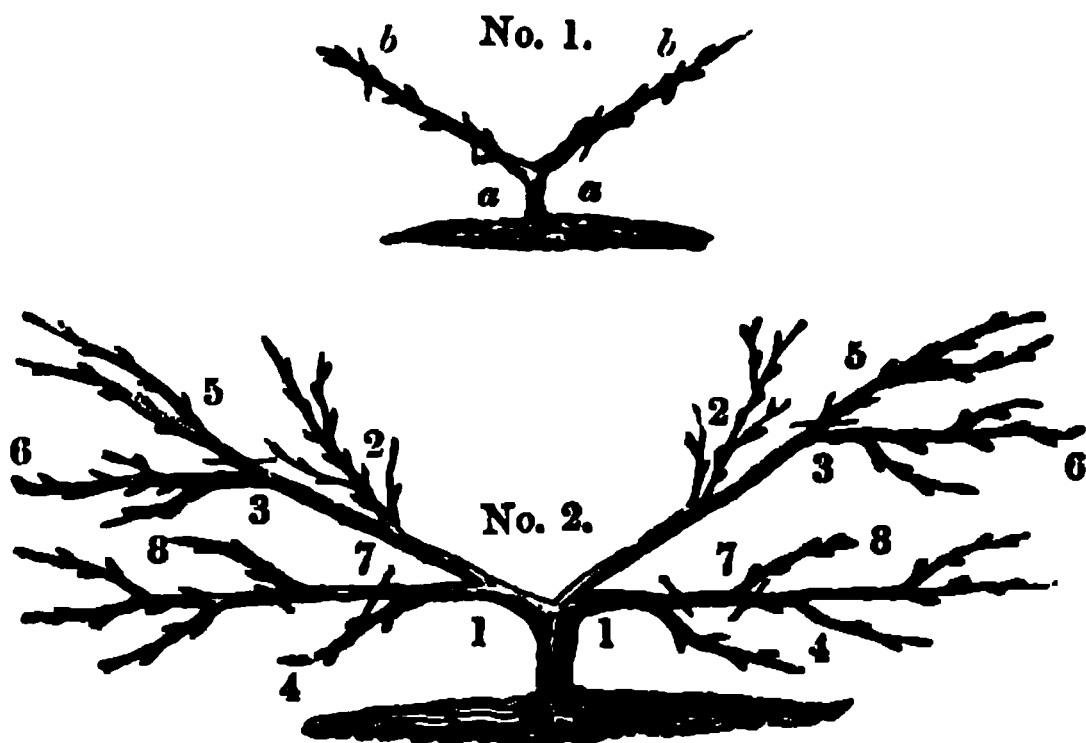
rally become fertile. If delayed till August, the vital principle will not be in sufficient activity to produce bearing buds in due time; on the contrary, if performed too early, a forest of young *wood* will hamper the pruner, cause him unnecessary trouble, and deform the tree. One good bud at the base is of more value than twenty wild and straggling twigs.

726. *Fan-training* is practised, almost universally, upon the peach and nectarine trees, and occasionally upon the apricot; to which, however, Harrison considers the half-fan, half-horizontal mode of training, to be the most suitable.

727. *French or Montreuil method of training the Peach-Tree.*—By comparing the description of Mozard's mode of training, described in the *Encyclopaedia of Gardening* (No. 4504, from *Hort. Tour*, 452), with the very perspicuous instructions in the *English Gardener*, I have endeavoured to draw up a set of directions which may, without difficulty, be understood and reduced to practice.

The tree being planted (a maiden-tree), it is cut down to four or five buds above the graft, to make it produce as many branches. These branches are trained and nailed right and left in regular order, but the weaker of the shoots are somewhat more elevated than the stronger, with a view to promote energy and vigour of growth. At the first regular forming,—that is, about eighteen months after the planting of the tree,—the branches are reduced to two on each side, all foreright and back-projecting, and other ill-placed shoots being constantly removed as they appear; then, at the next winter-pruning, two shoots of equal vigour are selected—the others are removed; and thus two principal branches only remain, and these are trained right and left, as shown at No. 1, figure 41.

Fig. 41.



728. *Second Year,—Winter Pruning.*—Two secondary branches are procured by cutting back the two branches at the mark *a'*, *a'*, in a sloping direction, a quarter of an inch beneath two *upper* buds. These, when they shoot, will lengthen the mother branches, and the *lower* buds will send out two lower lateral branches (No. 2—1, 1). Nail in, so as to leave the mother and lateral branches about two feet apart. Continue to remove foreright and ill-placed twigs.

729. *Third Year,—Winter Pruning.*—Obtain two more branches, by pruning back the mother branches—still represented by No. 1—to upper buds, as *b*, *b*; but take off the two intermediate lower buds. The effects will be the production of the two shoots, 2, 2, No. 2, and the prolongation of the main branches to the points 3, 3, or further. At the same time, procure fruitful secondary shoots, 4, 4, and lengthen the first secondary lower branches, by pruning 1, 1, at parts whence the upper buds may lengthen the leading shoots in the direction of 7, 7, and the lower buds may produce the shoots 4, 4.

730. *Fourth Year,—Winter Pruning,*—is a repetition of the foregoing operations; and conformably therewith, the writer of the *Horticultural Tour* informs us that “continued care is exercised to keep both sides of the tree equally balanced as to vigour. If one principal arm become stronger than the other, the weak arm is altogether raised a little more towards the vertical, while the stronger is depressed more to the horizontal, and thus an equality is gradually accomplished.”

731. *Fifth Year,—Winter Pruning.*—Prune near the marks 3, 3, between two upper and two lower buds. The former will continue the leaders 5, 5, and the latter will produce 6, 6.

732. *Sixth Year,—Winter Pruning.*—The lower secondary branches, if pruned at the marks beyond 7, 7, will procure two fruitful shoots, 8, 8, and also a continuation of the horizontal branches\*. Thus the tree is formed; and now, the regulation of the fruitful shoots may become the chief object. “When the tree reaches the top of the wall, and the cutting-in is discontinued, and the pruning extends only to shortening the leading shoots, or, in some cases, bending them till they be confined about two or three inches below the coping of the wall. In this way, the equal distribution of the sap in the central parts of the tree is promoted. In the regular course of pruning, all branchlets that show *fruit-buds only*, are sacrificed without mercy: this would appear absurd to any one not a horticulturist; but if such branches do exist, their excision is

\* Compare Harrison's mode of forming the peach-tree.—*Treatise on Fruit-Tree Culture* &c.

quite prudent.”—(See Knight’s Remark, No. 702.) “From four to eight flower-buds are left on each twig, according to its strength, and a wood-bud at the extremity when it can be there had, or between two flower-buds near the extremity. When this wood-bud expands into a shoot, the shoot is shortened to an inch or so in length. Other wood-shoots, as they are called, which may appear below the fruit-buds, or nearer the main branches, are cut down to one or two eyes.”

Experience has proved, that the method just described is productive of much delay. A better would be to adopt the old fan or ‘peacock’s tail’ training; or the new form suggested by Seymour, the principle of which is alluded to in the article on the peach (No. 85, p. 81). A maiden-tree, as I have ascertained, can furnish two, three, or four primary shoots, in the first season, on each side, if it be planted in October of the preceding autumn. Seymour’s mode is not unlike espalier, horizontal training, an idea of which may be collected by referring to Harrison’s treatment of the plum and apple-trees.

### PART III.

#### OPERATIONS PRODUCTIVE OF FRUITFULNESS.

733. *Renewal of the Soil*.—The nature of the materials that may be required in order to effect any material change in the habits of a tree or plant, must depend in a great degree upon its natural character. If the soil be poor, hungry, and sandy, it may be enriched or ameliorated by the fresh soil of a meadow, by vegetable compost, and by cow manure. Harrison says,—“About half of the worst part of the soil must be taken entirely away, and a suitable portion of fresh loam, moderately enriched with cow-dung and vegetable manure, must be substituted in its place.” If the soil of a *fruit-border* require renewal, attention must at the same time be paid to the roots of trees; and hereby a fair opportunity will be afforded of trying a second mode producing fruitfulness; namely,

734. *Pruning the Roots*.—Harrison directs, “all damaged parts to be cut off four or five feet from the end of every strong root which may have got to the extent of the border, and to prune away such as are inclined to the under stratum.”

Beattie, gardener at Scone, observes, “In the beginning of July, 1811, I had a border on the south wall 400 feet long, trenched to the depth of from two and a-half to three feet. In doing this, I had the opportunity of cutting the roots of all the trees as the work went

on, which I did so completely that they in a manner hung by the nails and shreds, with a ball of earth of about two feet from the stem of the tree. As cutting the roots of fruit-trees has a tendency to make them fruitful, that may possibly proceed from the small quantity of fibrous roots produced by the operation.”—(*Encyc.*, 2163, from *Oaled. Mem.* I., 272.)

The pruning of roots is seldom resorted to in practice; but it serves to write about. A healthy soil, free from manure, is the best security. I have witnessed the effects of a partial and gradual renewal of a soil in a very fine kitchen garden, at Shottesbrook, Berks. A portion of the old earth, perhaps a yard in width, and eighteen inches in depth, is taken carefully out on one side of the wall-tree, and the fresh turfy loam of a pasture, chopped small, is substituted for that removed. Diseased roots can thus be attended to, and, as the greater part of the roots remain undisturbed, little check is given to the tree, and this little is more than counteracted by the healthy stimulus afforded by the new soil. In three years, the entire soil can thus be renewed; and the tree equally benefited as if it were planted in a new border.

735. *Ringling*.—This operation, which embraces a twofold object, is also termed the *annular excision*. It “was known to the Romans, and is mentioned by Virgil, Columella, &c. Among the moderns, it seems to have been revived by Du-Hamel in the beginning of the eighteenth century, more especially in 1733, when he perfectly succeeded in rendering trees fruitful; and has given an account of his experiments in the *Mémoires de l'Académie des Sciences*, A.D. 1788.”—(*Encyc. of Gard.*, 2167.)

(1st.) *Production Ringling* is practised for the purpose of inducing the formation of blossom-buds; the descent of the proper juice is thereby interrupted, and lateral action excited. The operation should be performed in the spring on luxuriant trees, either on the main stem, in order to affect all the branches, or on individual secondary branches, to produce a partial effect. I have practised ringling—observing great caution—and, generally, with certain good results: it does not, however, produce any sensible effects till the year following the operation. D. Van Mons, of Brussels, has lately written luminously on this subject.

(2nd.) *Maturation Ringling* is calculated, as the term implies, to promote the earlier ripening of the fruit. It ought not to be performed till the blossom is fully expanded, and perhaps not till the fruit is setting. As an example, “Williams of Pitmaston described a mode of making annular excisions in the bark of vines. These were made *rather less than a quarter of an inch in width*, that the

exposed wood might be covered again with bark, by the end of autumn. "Two vines of the white Frontinac," he says, "in similar states of growth, being trained near to each other on a south wall, were selected for trial. One of these was experimented on (if I may use the term),—the other was left in its natural state, to form a standard of comparison. When the circle of bark had been removed about a fortnight, the berries on the experimented tree began evidently to swell faster than those on the other, and, by the beginning of September, showed indications of approaching ripeness, while the fruit of the unexperimented tree continued green and small. In the beginning of October, the fruit on the tree that had the bark removed from it was quite ripe; the other only just began to show a disposition to ripen, for the branches were shortly afterwards destroyed by the autumnal frosts. In every case in which the circles of bark were removed, I invariably found that the fruit not only ripened earlier, but the berries were considerably larger than usual, and more highly flavoured.—(*Encyc. of Gardening*, 2168.)

The above appears to be a decisive experiment: the *white Frontinac* is in the catalogue, classed as a "*hot-house grape*;" and if such grapes can be brought to maturity in September, by cautious ringing, there can be no hesitation in adopting the practice.

736. *In performing the operation*, either for production, or maturation of fruit, the rings of bark to be removed should scarcely ever exceed in the diameter those mentioned by Williams,—say from one-fourth to one-third of an inch. If less than the smaller of these proportions, the wound will almost immediately be filled up, as I have witnessed; but even then, I am almost certain that fruit-buds will be produced. "When," observes the *Encyclopædia of Gardening*, on the authority of Bourrelet, "the rings are made so wide that the barks cannot unite for two or three years, the result will be to accelerate the production of blossoms, and the setting of fruit, and to augment their size during the first year; and then, during the following years, to make them languish, and at last die.—(No. 2171.)

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## SECTION II.

## PART I.

NATURAL HISTORY AND CULTIVATION OF ESCULENT  
VEGETABLES.

Subject 1. HORSE-RADISH: — *Cochlearia Armoracia*; *Cruciferæ*.  
Class xv. *Tetradynamia*, of Linnæus.

737. *The Essential Generic* character of the genus *Cochlearia*, according to the *English Flora*, is, *pouch* nearly entire, turgid, rugged, of two valves, *seeds* numerous. The cotyledons are accumbent; that is, their edges meet the *embryo* longitudinally on one side.

738. *The horse-radish* is a native of Britain, and is commonly found on waste spots about farm-houses; originating, doubtless, in the refuse of the garden. The *radical leaves* very large, crenate (round-notched), those of the stems lanceolate, serrated, jagged, or deeply and narrowly pinnatifid. *Flowers*, white in numerous corymbs, becoming clusters of notched pouches, of which, most prove abortive. *Style* short. *Stigma* large, capitate. *Root* long, cylindrical, white, and highly pungent, running deep into the ground, and extremely difficult of extirpation.—(*Eng. Flora*, Vol. III., 178.)

Horse-radish is a useful aromatic stimulant, and ought always to be cultivated, though not in the garden: a waste spot of ground twelve or fourteen feet square, in a field or yard, being its proper situation.

739. *Cultivation*.—No vegetable can be of more easy culture; but to obtain fine, large, and unforked roots, particular management is required. Pure generous loam, not clayey, but of rather a compact and firm texture, free from intermixture of decaying vegetable matters, appears to me to be the appropriate soil. Whatever manure is applied, it should, as Judd observes, be confined to the bottom of the trench or bed, “for if not so done, the horse-radish, which always puts out some side-roots, would send out such large side-roots from the main root in search of dung lying contiguous, as materially to injure the main crop.”

Judd and Abercrombie agree in trenching the ground to the depth of two feet; but Knight trenches three feet deep. Abercrombie's directions accord sufficiently with the practice of both these modern cultivators: he plants in holes made by the dibber, as well as in open trenches, putting in the sets as the work proceeds; the season for planting may be any time from October to March.

740. *Trench-planting*.—Open a trench fifteen inches wide, and

of about the same depth, make the bottom level, dig it, and then strain the line exactly along the middle of the trench. The roots of horse-radish are so replete with dormant germs (pre-organized germs, according to Du-Hamel), that the smallest particle will protrude buds and roots; but the best sets are made of cuttings of the upper parts of the roots; that is, of the crown, or the part below the crown, to the extent of three inches. Cuttings of an inch long will do very well, of which, each root will furnish four. Plant a row of these along the line, twelve inches apart; then measure the distance, so that the centre of the next trench be exactly fifteen inches from the centre of the planted trench; into which, cast the earth that comes out of the next trench; and thus proceed, trench after trench, till the bed be completed. In dibble-planting, Judd fills up the holes with sifted cinder dust.

741. *Subsequent Culture*.—Mr. Knight's mode of culture appears to me to comprise every requisite for the production of the finest roots; it is thus described. He premises that the ground be previously trenched three feet deep, and that there be two or more beds side by side; each bed is to be four feet wide, with one-foot alleys between the beds. Nine inches of the soil is to be taken from the top of the first, and laid on the surface of the next adjoining bed; then the first bed is to be trench-digged, and planted with crowns only, the trenches to be fifteen inches deep, and the sets nine inches apart each way. The trenches will be planted one after the other as before directed, but the *alternate beds only* will be cropped; thus if there be four beds, the first and third will be planted, the second and fourth will be vacant; and moreover, their surfaces will be higher by nine inches than the surfaces of the first and third. "The plants must be kept free from weeds; and as soon as the leaves decay in autumn, let them be carefully raked off with a wooden-toothed rake. In the following February, *eighteen inches* of the earth of the unplanted beds must be laid as light and equally as possible over the beds that are planted; then trench and plant the vacant beds exactly in the same manner as before directed. The following autumn, the first-planted horse-radish may be taken up, by opening a trench at the end of the bed to the bottom of the roots, so that the sticks or roots of horse-radish may be taken up entire and sound, which for size and quality will be such as have not been generally seen. The following February, the one-year old crop will require additional earth as before" (eighteen inches), "which must of course be taken from those beds that are vacant, which, when done, if the ground appear poor, or unlikely to produce another vigorous crop, they must have a coat of manure."—(*Hort. Trans.*, I., 207. *Encyclopædia*, 4113.)

Subject 2. RHUBARB:—*Rheum*; *Polygonaceæ*. Class ix. Order ii.  
*Enneandria Trigynia*, of Linnæus.

742. *Essential generic character*.—*Flowers* produced in spikes or panicles; *Calyx* six cleft, permanent; *Corolla* none, unless the calyx be, as Professor Martyn considers it, a corolla; *seed* one, three-sided.

743. *Rhubarb* is a perennial plant: three of the species are now cultivated, the rhapontic or Thracean, the hybrid, and the palmated-leaved.

(1.) *Rheum Rhaponticum*, introduced in 1573, has smooth leaves, and somewhat furrowed; reddish footstalks; it is the species commonly cultivated in gardens. The stalks of the leaves, after being peeled, are cut into pieces and made into pies or tarts.

(2.) *Rheum Hybridum*, a native of Asia, introduced in 1778. Leaves large and smooth, somewhat heart-shaped, produced upon very long pedicles, or foot-stalks, which frequently measure two or three feet: these are also peeled and used in pies and tarts.

(3.) *Rheum Palmatum*, a native of Tartary, introduced about 1738. Leaves hand-shaped, deeply cut, the lobes or divisions pointed. The foot-stalks may be sometimes used as the other species; but the roots, producing the genuine Russian or Turkey rhubarb, are sometimes dried, and employed as a medicine. (See *Encyc. of Gard.*, 4196-9.)

(4.) The large *Scarlet Goliah* is a species or variety raised by a Mr. Radford. Its leaves frequently measure two, three, or even four feet across, with footstalks being from eighteen inches to thirty inches in length. For open ground culture it stands unrivalled. The texture is crisp and tender; the flavour delicate, and mildly sub-acid. I have found this acid to be the binoxalate. The yield is enormous, and the stalks may be pulled from the middle of April to the close of August. Peeling deteriorates the flavour.

(5.) Several sub-varieties have been introduced of late years:—1st, An early yellow stalked; 2nd, Bucks Scarlet; 3rd, Youell's Tobolsk. All are dwarfs, solely applicable to forcing, each under a pot, like sea-kale. The colour is their great recommendation.

744. *Propagation and Culture*.—All the sorts may be raised from seed, or by dividing the roots. Sow the seeds, as soon as ripe, in a hot-house; and when the young plants attain an inch in height, transfer them to pots; subsequently, to beds of rich, light earth, well pulverized, and richly manured to the depth of two feet. The plants of the two first species may be set, finally, in rows three feet asunder, the plants two feet apart; but the hybrid rhubarb will require a space of

from three to four feet between plant and plant; hence, the beds should contain only two rows of the latter, and three rows of the two former species. The subsequent culture consists in keeping the rows free from weeds, in being careful to loosen the soil between them with a fork, and manuring with rich vegetable compost every autumn.

745. *Taking the Leaves, and Method of Blanching.*—In the first season after planting, some of the leaves may be taken off: remove a little of the surrounding soil, and detach the leaf by a pull sideways, not by cutting with the knife. Knight's method of forcing and blanching is particularly worthy of attention. He says:—

“The root of every perennial herbaceous plant contains within itself, during winter, all the organizable matter which it expends in the spring, in the formation of its first foliage and flower-stems; and it requires neither food nor light to enable it to protrude these, but simply heat and water; and if the root be removed entire, as soon as its leaves become lifeless, it will be found to vegetate, after being replanted, as strongly as it would have done, if it had retained its first position. These circumstances led me in the last winter, to dig up the roots of many plants of the common rhubarb (which I had raised from cuttings in the preceding spring), and to place them in a few large and deep pots, each pot being made to receive as many as it would contain. Some fine sandy loam was then washed in, to fill entirely the interstices between the roots, the tops of which were so placed as to be level with each other, and about an inch below the surface of the mould in the pots, which were covered with other pots of the same size, inverted upon them: being then placed in a vinery (in a situation where nothing else could be made to thrive, on account of want of light), and being copiously supplied with water, the plants vegetated rapidly and strongly; and from each pot I obtained three successive crops, the leaf-stalks of the two first being crowded so closely as nearly to touch each other over the whole surface of the pots. As soon as the third crop of leaves was broken off, and a change of roots became necessary, those taken from the pots were planted in the open ground, their tops being covered about an inch deep with mould. Should they perish,” he adds, “it will be of little consequence, as year-old roots, raised from cuttings, or even from seeds, sown in autumn in rich soil, will be found sufficiently strong for use. The heat of a hot-bed, a kitchen, or other room, and, on the approach of spring (probably at any period after the middle of January), a cellar, will afford a sufficiently high temperature; and the advantages, in all cases, will be that of obtaining from one foot of surface as much produce as in the natural state of growth would occupy twenty feet,” &c.—(*Encyc. Gard.* 4204.)

## PART II.

OPERATIONS IN THE VEGETABLE GARDEN FOR THE  
MONTH OF DECEMBER.

746. These are few, and frequently useless; but there are open seasons when it may be prudent to—

*Sow* a few early frame or charlton peas (26), beans (22), radishes (351); all to be protected with long litter or fern-leaves.

*Earth up* peas, beans, broccoli, &c.

Attend particularly to the directions for January (No. 36), and to those for the last month (668).

## SECTION III.

## PART I.

## CULTIVATION OF THE GRAPE-VINE.

## PLANTING AND TRAINING THE VINE.

747. THERE are three methods of managing the vine which appear to me to merit peculiar attention; these I shall describe. The first is the method of *long training* recommended and practised by Harrison; the second is the *fan*, or fruit-tree method; and the third is the *espalier* method, or that in which the tree is trained against an espalier trellis.

## 1. METHOD OF LONG-PRUNING AND TRAINING.

748. *The Soil, and preparation of the Border.*—The compost which Harrison recommends for the vine, and that in which he finds it to flourish best, is thus prepared. One half of good gritty loam—the top spit of a pasture which has not lately been cultivated for corn, or of a common, the turf remaining upon it; one quarter of well rotted manure from old hot-beds, and one quarter of a com-

post of lime rubbish, bone dust, old spent bark, and pigeon's or fowl's dung, in equal quantities. The soil is to be procured twelve months before it is used, and to be frequently turned over, and chopped over, in dry weather. The manure and soil are to be thoroughly mixed before they are placed in the border, and when there, the compost is to remain three months before the vines are planted in it.

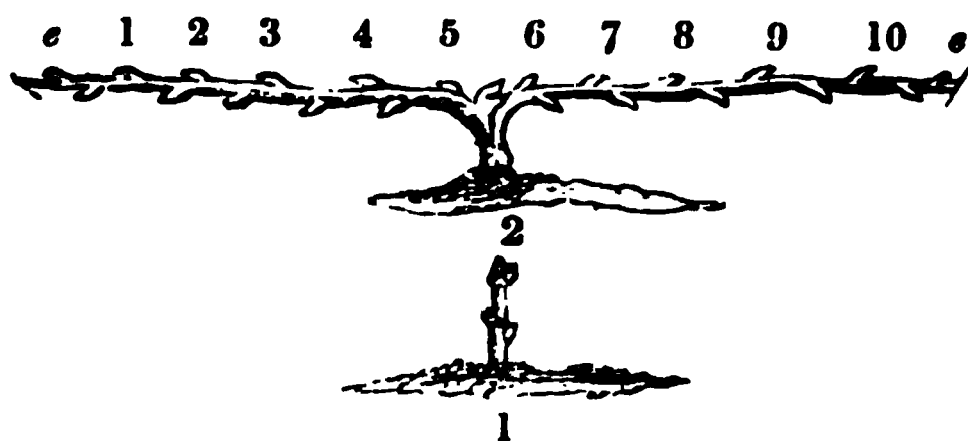
749. *Planting*.—Suppose the vine to have been raised in a pot, either from a cutting, a bud, or a layer (the bud or eye is what the author prefers), then, in the spring, when danger from frosts is no longer apprehended, the vine may be planted. The hole for it is to be three feet wide, and fifteen inches deep. When the plant is turned out of the pot, the roots, if matted together, are to be loosened, so that they may push directly into the border. Let the ball of earth be laid on its side, on a quantity of fine earth, sufficient to raise it to a position wherein five eyes may lie horizontally upon the earth—three on the underside, and two on the upper; and so deep in the hole, that the upper side of the ball may be six inches below the surface. When so placed, and supported with fine earth, a slit is to be made below each of the three buds, beginning about an inch below them, and so deep, as to pass through one-third of the thickness of the shoot. “When the three tongues are cut, let a little soil be put between them and the other part of the wood, so that the tongue will form an angle of 45 degrees with the stem.” Care is to be taken not to break the stem, and all being safe, the hole is to be filled up, and the parts around the roots are to be watered and mulched. Against a wall twelve feet high, vines are to be planted twelve feet apart.

As the vine pushes, it is to be carefully trained straight up the wall, and if it reach the top it is to be stopped; all claspers and lateral shoots are to be taken off, leaving only one single, clear stem.

750. *First Year,—Winter Pruning*.—Cut down to three buds before they begin to swell. Cover the vine and parts adjacent with a woollen net, give a gentle fire-heat if the wall be flued or hollow, and continue the covering and fire till there be no more danger from frost. “If all the three buds push shoots, let the two uppermost be retained, and rub the lowest one off; and if there be any bunches of fruit shown, let them be pinched away. The shoots must be trained horizontally for six feet from the bole, one on each side; at that distance the direction of each shoot must be changed, so that they may afterwards run straight up the wall. After they have pushed three feet in the erect position, let about two feet be cut off the

end of each shoot ; and when they push again, and have grown a foot or two, let them be stopped. All laterals and claspers which are hereafter produced upon the vine must be taken off as already directed."

Fig. 42.



751. *Second Year,—Winter Pruning.*—Both shoots are to be pruned back to that part which is in a horizontal direction, so that each will be six feet long from the bole of the vine. The tree will then resemble the drawing at 2, figure 42. No. 1, exhibits the vine when it was cut down to three eyes, at the first winter pruning. Harrison directs, that, at this period, the walls be washed with a compost of soap, sulphur, and black pepper, boiled in water, and that this washing be attended to every year ; but if washing be needful, I propose to substitute the *clear liquid sulphuret of lime*, so frequently alluded to, for all other washes whatsoever. Cover with nets, and renew fire-heat where there is the convenience of a flued, or hollow-built wall.

752. *Spring Regulation.*—At this period—being the third year after the planting of the vine—when the buds have pushed to the extent of two inches, every one must be rubbed off excepting those which will be required to furnish the tree in the manner now to be described.

The *endmost* shoot upon each horizontal branch (e, e), must be trained straight up the wall, and so must ten others (1—10), each ten inches apart. The retained shoots are to be allowed to run to the top of the wall, and there be stopped ; and if they push a second time, they are again to be stopped. The tree is now completely formed—that is, it is furnished with twelve perpendicular productive shoots, arising from two horizontal branches.

“All bunches of fruit which are shown upon the shoots trained in must be retained ; and when the berries are at a proper size, the bunches must be thinned. When the fruit is beginning to change its colour for ripening, a little fire-heat should be applied until the fruit be ripe.”

753. *Third Year,—Winter Pruning.*—All the upright shoots

must now be cut down above a bud, so as to leave them *four feet* long. These shoots are now one year old, they therefore will produce bearing shoots from their buds on each side; and “all the bunches of fruit which are shown the following spring must be retained, excepting upon the *lowest* new shoots, which must be trained up close by the side of each mother branch.”

Thus, there will be twelve primary leading shoots, each producing, and accompanied by, a secondary or succession shoot. These succession shoots, “when they have attained six feet in length, must be stopped by cutting off twelve inches, and afterwards keeping them at that length,” (five feet). “Also the uppermost new shoots upon each branch, must be trained straight up the wall, and be stopped when they reach the top.”

All the young fruit-shoots upon the branches are to be stopped at two joints above the fruit, and kept at that length. They are to be trained in and nailed to the wall, and the fruit must be attended to as before directed.

754. *Fourth Year,—Winter Pruning.*—The leading shoots on the primary branches are now to be cut down, so as to leave four feet of the new last summer's wood: they will then be eight feet long; the half of which—the lower part—is of two years old wood; and from this, all the side shoots that bore the fruit of the last summer, must be cut clean away, leaving the lower half of the branch naked, and entirely barren.

The *secondary shoots* are to be cut off opposite to the termination of this barren part, that is, at four feet above the horizontal branches. Here then are two shoots to each ascending branch, where last year there was but one—namely, the primary leader, now eight feet long, and the secondary shoot, now four feet long. During the summer another shoot must be trained from the bottom of each of the first, but on the side opposite to that produced last year: this new shoot must grow to six feet, be then reduced to five feet, and kept at that length; the other branches are to be stopped at the top of the wall.

755. *Fifth Year,—Winter Pruning.*—“The *leading* shoots must be cut off at twelve inches from the top of the wall. The *second* shoots to a bud, opposite to the part where the leading ones were cut to at last winter's pruning, and the *lowest* shoots at four feet. All the laterals that have borne fruit must be entirely cut away. During the ensuing summer another

Fig. 43.

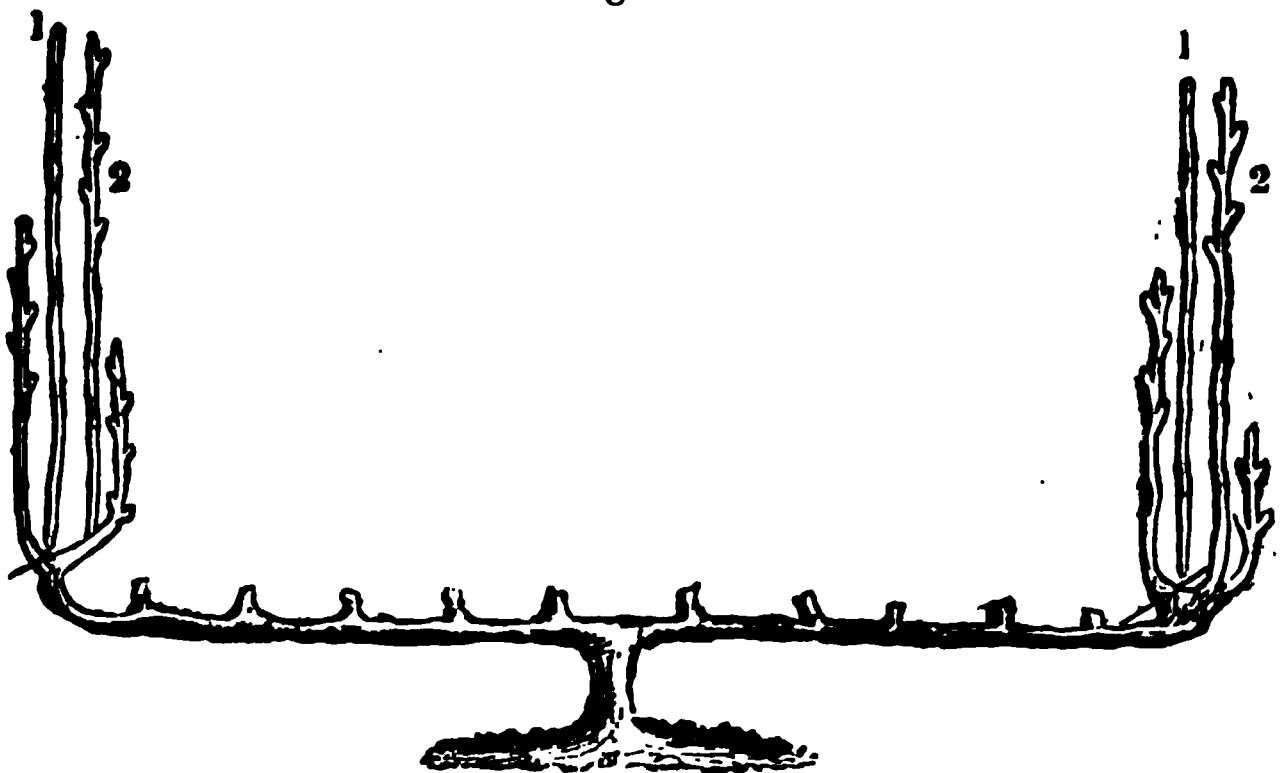


shoot must be trained from the bottom of each branch, at the opposite side to the one trained in last summer." The other shoots, and the fruit-bearers, must all have the same attention as before laid down.

Figure 43 represents one of the twelve perpendicular branches and its appendages, as they appear during the present summer. *h*, is a portion of the horizontal stem; 1, is the primary leader, bearing grapes on the laterals at its top; 2, is the secondary branch, with fruit on laterals produced from its upper half; 3, is the other secondary branch, now four feet long; 4, is the embryo of the *fourth* shoot, that is, of the present summer; *e, e, e, e*, point to the laterals that have borne fruit, and been pruned off.

In some vineries entire grape-trees are occasionally trained thus:—each tree being composed of four branches proceeding from a main, *upright* stem, with its root near the place indicated by the letter *h*. On walls, also, vines may be so trained, by layering single branches, and training up—first, a leader from each rooted branch, and, afterwards, the secondary branches: thus one vine may be led by layers till it furnish an entire wall.

Fig. 44.



756. *Sixth Year,—Winter Pruning.*—All the leading primary branches, 1, 1 (figure 44), are now to be cut entirely away to the origin of the first secondary branches 2, 2, which are to be pruned off at one foot below the top of the wall. The other two shoots are to be pruned according to the previous instructions. "All lateral shoots which bore fruit are to be cut clean away."

"The system of management now detailed," observes Harrison, "must be practised every future year, by shortening the shoots, cutting away entirely the lateral ones that bore the first season, also

in training up young ones from the bottom of the branches every year; and it may be pursued for a great many years without exhausting the vines."—(Edit. I. Selected from HARRISON'S *Treatise*, 285.)

This system of training, plausible as it may appear, has been proved to be essentially erroneous. Mr. Hoare's treatise on the vine has thrown great light upon the scientific management of the tree, grounded upon its physiological structure. The chief defects of the ordinary practice consist in permitting the vine to bear fruit too soon, and to be crowded with a redundancy of wood.

In lieu of requiring twelve upright shoots from the two horizontal branches, it would be better to retain half the number only, at eighteen inches asunder; rubbing off all the buds on the lower side of the horizontals; and those also on the upper side, situated intermediately between perpendicular shoots. These may be permitted to grow on to the end of August; but should then be cut back to leave them nearly of an equal length; the stopping will tend to strengthen the branches and their buds; and as soon as the wood is ripe, every other branch must be pruned down to within an inch above the second lowest bud, and the remaining shoots to four or five feet above the horizontals. The tree is now presumed to be four years old, and to have borne no fruit; it is furnished with *four bearing* branches, and *four spurs between them*. In the fifth year, if the central stem be strong,—an inch or more in diameter,—each shoot may be permitted to bear three or four clusters.

The system is not new, but the practice is enforced by a power of reasoning and argument, that is entirely so. The bearing branches are renewed every year, and are cut down to a lower bud alternately after every crop.

## 2. FAN, OR FRUIT-TREE METHOD.

757. *General Directions*.—From a single stem, raised and treated as before directed, and cut down to five or six eyes, lead off as many shoots to right and left, and train them at various angles, so as somewhat to resemble the sticks of an expanded fan. Nail them regularly to the wall, at from twelve to fifteen or eighteen inches asunder, as bearers. These branches form the basis of the future tree; and now the young gardener should remember that his future operations must be guided by the circumstance, that the grape-vine produces its fruit upon shoots of the *current year's wood*, proceeding from branches of the *preceding year's wood*: and this almost without any exception, though it may be admitted—and I

assessed the fact—that the July shoots, proceeding from the shoots of the same year, will occasionally produce a few bunches of flowers. With the above-named leading fact in his eyes,—and remembering, also, that the vine will require regular yearly prunings, one in November, and the other after summer; and that its buds and shoots ought to undergo three regulations during the spring and summer,—he is to train annually, a supply of every year's young shoots, during the summer, as the succession bearers of the next year, leaving them, in most part, at full length during that season. In winter, he cuts in out the worst and redundant shoots, leaving a general skeleton of the strongest, for the next year's mother bearers, and leaving them to a few eyes.

The annexed figure, 45, exhibits the vine, its branches and shoots pruned and trained at the November pruning, when in its fully developed and bearing state.

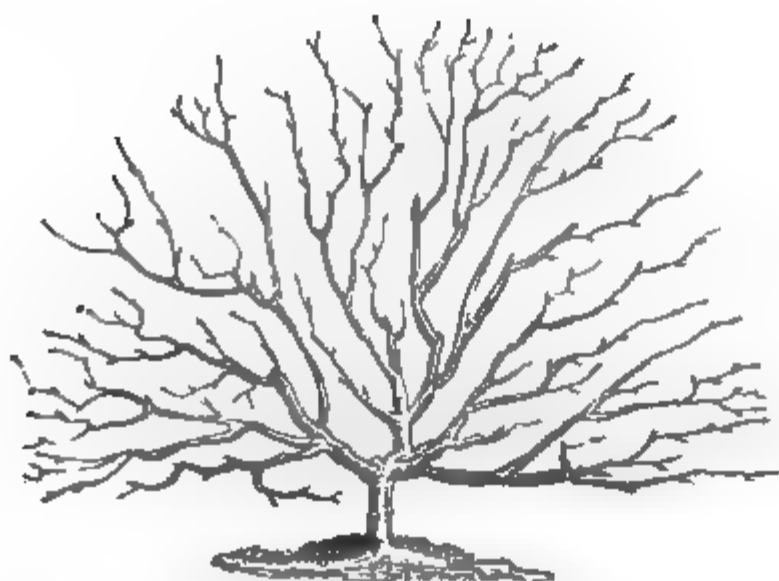


Fig. 45.

A proportionable share of the former bearers, and old wood, should be annually cut out in winter; and each bud of the reserved shoots will produce a fruit-shoot next summer, furnishing an immediate crop of grapes, each probably from two or three to eight, or ten, or more bunches."—(See ASHERCROMBIE'S *Dict.—Viticulture*.)

### 3. ESPALIER-TRAINING.

8. The *Encyclopædia of Gardening* says nothing of this method of training: it merely observes, that under such treatment the fruit does not come to the same degree of maturity as on walls. "When made from green grapes, as is now very frequently done, the former may be preferable to growing the vine as dwarf standards."

A mode of espalier-training is very perspicuously described in the *English Gardener*; a drawing is annexed, and from it I have taken the figure that is intended to illustrate the following description.

759. *Erection of an Espalier-rail.*—The situation and aspect of the trellis have been detailed in the paragraph No. 542; the materials should be some imperishable wood; and the preference ought to be given to that of the Acacia, Elder, or Laburnum. Young trees, with clear erect stems, six or seven feet long, and from an inch and a-half to two inches in diameter, would furnish the most durable upright stakes for the rail.

The bark being removed, the lower ends are to be painted to the extent of fifteen or eighteen inches, with coal-tar; and when this has become dry, the stakes are to be driven into the ground so deep as to leave one inch of the coating of tar visible above the surface. In order to regulate the direction, a line must be strained very tight, and with the utmost precision along the site of the intended rail; the distances between the uprights are next to be measured, and marked with small sticks. The line being removed, each hole is to be made with a crow-bar; the upright is next to be placed in the hole, and driven in to the required depth, and then, the stakes are to be joined, and kept in a line at the top by a rail of spine-oak, or an iron hoop, through which a nail is to be driven into the heart of each.

I think that a double coating of white paint would improve the rail in appearance, and tend to prevent the growth of those mosses and lichens which usually infest old espalier rails.

For apple and pear-trees the uprights should stand about nine inches asunder; for vines double that distance might be allowed, provided that small rods or wire were affixed horizontally along the trellis, in order to guide and support the advancing shoots; the top rail ought in every case to stand four and a-half, or five feet above the level of the ground.

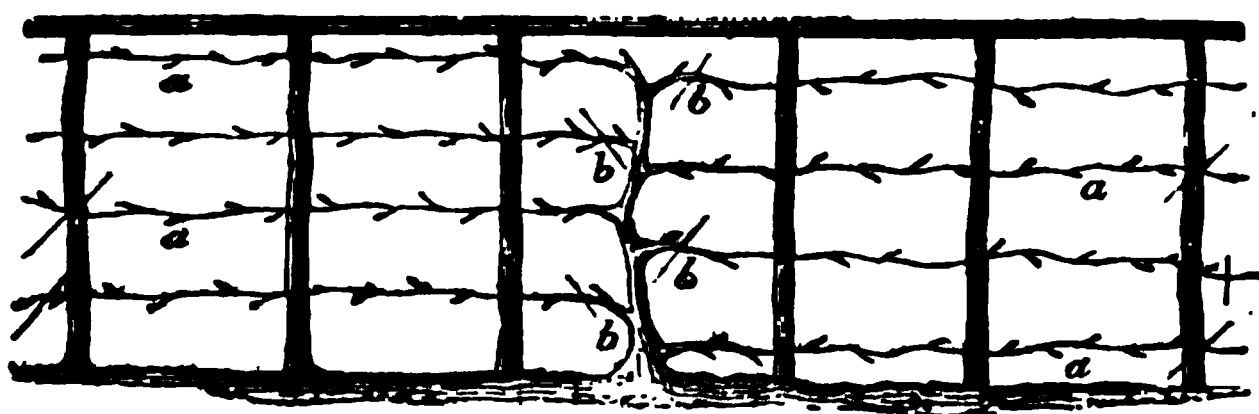
760. *Planting and training the Vines.*—The trees may be raised from cuttings or buds, planted at once in the places where they are to remain; or, each vine having been previously rooted in a pot, will be planted and treated as directed by Harrison (see No. 719). The distance between vine and vine must be sixteen, or rather eighteen feet. When the vine is planted, treat it according to the instructions already given, but, subsequently, instead of leading off two horizontal branches, suffer only one single leader to attain its utmost perpendicular growth, securing it to the espalier-rail as it advances, by tyers of soft bass or twine.

761. *First Year,—Winter Pruning.*—In November, when the young vine has shed its leaves, cut it off at an inch above a bud that

is nearly even with, or rather below, the top rail of the trellis. In the spring following, lead off four shoots at regular distances on each side of the central stem, and rub away every other bud or shoot. Train the eight shoots horizontally along the trellis, and if in the course of the summer they extend a foot or more beyond their prescribed limits, suppose to ten feet, cut them back to about eight feet six inches; and when they sprout again, let them be again stopped. Remove every lateral side shoot, so that nothing but the clear branches and their leaves remain.

762. *Second year,—Winter pruning.*—In November, cut off the ends of the branches, leaving each eight or nine feet long; and the vine will now appear as represented in figure 46.

Fig. 46.

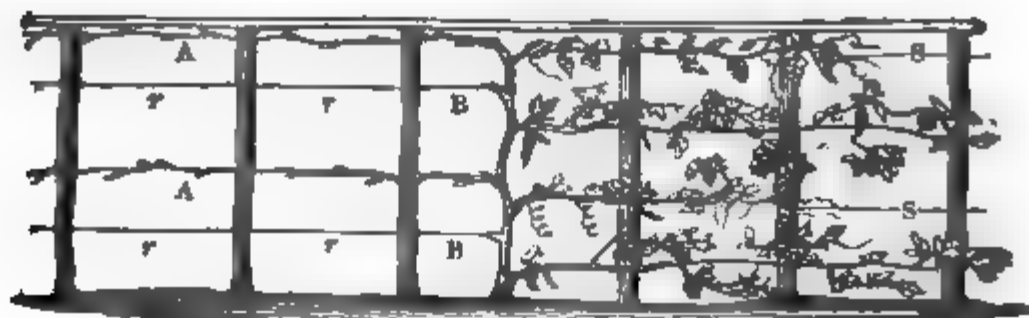


In order to prevent crowding, it will be needful to prune off every alternate shoot *b, b, b, b*, at the lowest bud next to the central stem; and in the spring, the four remaining shoots will send out a young bearing shoot from each of their buds, which will produce one or two bunches of grapes. The shoots are to be cautiously secured to laths, placed from upright to upright, at convenient distances, and when the grapes become as big as peas, the shoots are to be pinched off at one bud above the uppermost bunch; at the same time, the clusters ought to be thinned out with a fine pointed scissors, to the extent of at about one-fourth of their berries. This remark on *thinning the fruit* applies, however, solely to the finer sorts of grapes for the table, and on such, the operation ought, I think, to be performed twice; the first time, as above described; the second, about a month after the first; when the swelling of the fruit shall determine the proportion of berries to be removed. For immature, or inferior wine-grapes, thinnings out would not be required.

Four other shoots will now be advancing, two on each side: of these, two are exhibited at *s s*, fig. 47. In the drawing, the tree is represented at two distinct periods after the second winter's pruning. This is done in order to avoid needless figures, and also to enable the reader to observe the result of the operation then

performed. A, A, represent two of the four branches corresponding with a, a, a, a, of fig. 46; of which, two others, on the right hand

Fig. 47.



of the central stem, are seen bearing fruit. n, n, are two of the four branches b, b, b, b, of that figure, that were pruned down to one bud. s, s, are two branches advancing from such buds, to supply the bearing wood of the next year; they are to be trained horizontally as the present bearers were during *their* growth, and like them, are to be kept clear from laterals or claspers; r, r, r, &c. indicate the rods or laths to which the advancing shoots may be secured.

763. *Third and subsequent winter prunings.*—Cut down all the four branches, a, a, a, a, fig. 46, which bore the fruit of the preceding summer, to the lowest bud upon the young shoot on, and nearest to, the origin of the branch. This will be to lengthen the spur and its butt by one bud; but, as in the case of long pruning, other shoots will in the course of time be protruded either from the base of the branch, or from the main stem, and when one of these shall be found well situated, and strong, the old branch may be entirely removed. The main points to be attended to in pruning are—never to leave more than two bearing branches at full length, on each side of the main stem; to cut down the two alternate branches to one bud, or to the lowest bud that will produce a strong new bearer; and to remove all weak or ill-placed shoots. The figures 46 and 47 are to be taken as the future guide, with the consideration that the bearers of each succeeding year are to be produced in alternate order, and that, too, on both sides of the main stem.

The system corresponds with that of Mr. Hoare, in cutting out alternate shoots; but if the vine do not stand very near a south wall, it is not adapted to our chilly summers, unless, indeed, it be applied chiefly to the production of unripe grapes for wine making.

## PART II.

## OPERATIONS IN THE FRUIT DEPARTMENT.

764. *Plant* fruit-trees, if it be needful, but planting ought to be avoided, if possible, at this unpropitious season.

*Pruning* in very open weather may be attended to, if time press.

*Fruits* should be protected from frosts. Lay long litter, or straw, as mulch, between the rows of strawberry plants. Cover the roots of vines, peaches, nectarines, &c., with littery manure, or spent tanner's bark.

## MISCELLANEOUS.

765. *Prune* deciduous shrubs, cutting out entirely all superfluous shoots; then fork the ground.

*Protect* by littery manure the roots of tender shrubs. Clean grass-lawns, and gravel-walks, and remove litter of every kind.

“*Collect* leaves of trees of all sorts, and lay them in large heaps to rot for vegetable mould. If you intend to make hot-beds of them, they should be raked together when they are not wet; but if you intend them for rotting only, they must be brought together as wet as possible.”—(M'PHEAL.) Collect also fresh meadow-soil with turf and weeds, intended to form compost for fruit-borders. Mix these with cow-manure, and a moderate sprinkling of salt (457).

## THE NATURALISTS' CALENDAR.

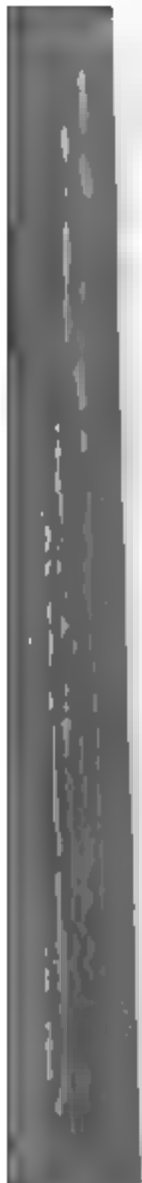
## DECEMBER.

AVERAGE height of the barometer, about 29½ inches.

Ditto thermometer, 40 or 41 degrees.

*In the second and third week*, early young lambs are dropped; moles (*Talpæ Europææ*) throw up hillocks.

*Fourth week*, blackbird (*turdus merula*) is sometimes heard to sing in very mild seasons. Red-breast (*motacilla rubicola*) sings.



# APPENDIX.

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## ON THE FORCING OPERATIONS OF THE GARDEN.

UNDER the term of forcing, are comprised all those processes which are begun, carried on, and perfected by the stimulus of artificial heat, whether that heat be produced by the power of fire, acting through the channel of smoke-flues, or by the medium of hot water, and by beds of tan, fermenting leaves, or stable manure, with or without the assistance of hot linings. Direct sun-heat, whatever be its power, is not considered as an instrument of forcing, although, in point of efficiency, it is incomparably the superior agent. We conform to terms, while we admit their improper application.

Solar heat, were it always present, would be more than sufficient to carry on every operation suitable to the various seasons of the year; but it is not under our control, or at our command, it becomes needful to create a degree of artificial heat from radiating surfaces, which shall approach to a medium, (or mean,) between that of the utmost power of sun at mid-day, and the greatest degree of cold during night, both acting through glass, upon an enclosed atmosphere. This definition is, perhaps, little more than an approximation to the fact; nevertheless it is certain that, in a clear day of mid-winter, the power of the rays is immense: far exceeding that (speaking comparatively) of climates in the tropics\*, or which is manifested during the hottest seasons of latitudes. It is by no means unusual to see the mercury in a closed thermometer raised in the shade to 105—110°, while the external atmosphere is cold; whereas in August there might be some difficulty to raise the internal temperature of a house to 100°, at the very moment when the external instrument marked 80°. This is one of the mysteries of light;

It is not uncommon in the neighbourhood of London for a thermometer in the sun to rise 50° of Fahrenheit above one in the shade. At Cumana, Mr. Storer never found the sun's rays to have the effect of raising the thermometer more than 6° or 7°. Nearer the pole the energy of the solar rays appears to be less than in this climate. Between latitude 80° and 81°, Captain Scoresby states that the thermometer was 18° below freezing on one side of the ship, whilst on the other the pitch was heated to a temperature of 90° or 100°."—*Penny Cyclopaedia*, Hot-houses.

it is one among a thousand which challenges inquiry, and claims "the superlative of praise."

Having thus generalized, the first subject which demands particular notice is:—

### THE VINERY.

This is the most important erection of the forcing department, and in its structure varies exceedingly. It is proposed, in the present article, to assume as a model a house erected for the express purpose of forcing an early crop of grapes upon vines in pots, to be succeeded by another later, or July crop, from vines grown in the house, and trained horizontally under the glass. Every amateur ought to be acquainted with the method of erecting forcing houses; and were he himself to take tools in hand, make and frame, glaze and paint, the wood-work, while superintending the bricklayer, (who ought to be a handy, adroit, jobber, at day-wages, amenable to the will of his employer,) he would speedily ascertain how comparatively small an outlay need to be incurred.

The heating of the house, steadily and efficiently, is the most material consideration; because, before a brick is laid, the proprietor should have fully arranged his plan, otherwise he may find himself at a loss, and hampered, just at the period when his operations ought to commence.

After all that has been asserted and written upon steam and hot water, it should appear that a well-constructed brick flue is equally qualified, and with more economy, to produce an ample and durable radiation of heat throughout every square inch of the vinery. But if, with all the pretended disadvantages of the old smoke flue, the foregoing assertion has been borne out by experience, what will be said now, that a discovery has been announced which is calculated to produce the complete combustion of all the smoke of the furnace, at a very trifling expense, but with the saving of nearly *half the fuel*.

The invention is just published, (August, 1838,) and patents have been secured; but, what is more to our purpose, a friend, on whom the utmost reliance can be placed, has examined the furnace, seen it in full action, and proved its capability, under conditions apparently the most adverse, to substantiate its utmost pretensions.

In investigating one of the furnaces, he saw the fire charged with a quantity of moistened coals, which produced a complete cloud of smoke from the chimney. At that moment, *with the door open*, by merely forcing a volume of steam upon the coals, from a fan-shaped jet, *decomposition* was effected; the *elements of the watery vapour acted upon the smoke*, and by electrolytic attraction converted them into steam and carbonic acid, attended with the developement of much additional heat.

A small boiler could be added ; or, what is better, a cast-iron furnace, of the simplest form, with a boiler attached to it, in the manner of the patent cooking-ranges, might be furnished with a steam-pipe, and its fan-like perforated jet, and be adapted to every flue with little expense\*.

These are little more than crude hints, which may easily be improved upon ; but, assuredly, if our hot-houses can be thus heated by flues, deprived of smoke, every advantage of heat and moisture, by means of vaporization from pans or troughs standing upon the flues, can be combined with the wisest economy of money.

Next in importance to the furnace is the *slope of the glass lights*. This ought not to be less steep than  $40^{\circ}$ , nor need it exceed  $45^{\circ}$ ; it will, in the latter case, form a right angle with the back wall ; which ought always to be made the standard of calculation. The solar rays will thus fall perpendicularly upon the glass, or nearly so, at the season of the vernal equinox ; and thus, in early forcing, be pretty equally distributed over the vines between the rafters, conferring vital energy upon the foliage, and stimulating into activity every developement of the growing, as well as the fruit-bearing plant.

The most *equable* temperature of a vinery is promoted by adopting that method of laying the bricks which is styled *cellular* work, particularly at the back wall of the house. By this method the bricks are laid on their edges,—*two* lengthways, and *one* across the ends of the other two, leaving a space or cell between the four. The cellular wall is described and figured at No. 465, Section I, page 413, September. It economizes bricks ; the building, though lighter, is thereby rendered more strong ; and the *plate of air* contained within the cells, when once heated by fire, or by the sun's rays, retains its increased temperature during many hours. I have repeatedly had occasion to allude to this circumstance elsewhere ; and having erected a house upon the principles thus detailed, can attest, upon experience, its utility during the rigorous frost of 1838.

Vineries differ in extent ; but thirty-six feet in length, by seven feet in breadth, inside measure, are good proportions ; the height of the brick-wall must be such as to provide for the slope, and allow of head-room below the trellis, and then "it will be of little consequence whether the lights rest on a front wall, eighteen inches or two feet high ; on a wall-plate, over a glazed front ; or, finally, descend to within a few inches

\* By suggesting this mode of adaptation, I deprecate any attempt to infringe upon the right of patent ; but surely the proprietors will turn their attention seriously to the assistance which they may render to the proprietors of forcing-houses ; now especially as foreign competition has materially reduced the prices of fruit, but not the expenses of production.

above the surface of the ground. In the front and end walls four-inch work will be quite sufficient.

A house erected by Mr. Carrington, of Missenden Abbey, chiefly for vines in pots, is about fifty feet long; the lights slope nearly to the ground, and the rain which falls upon them, passes along a gutter-pipe into a sunk reservoir, close at hand. A *tank* is, in fact, an indispensable appendage. This vinery was at first heated by a single flue; in front of it is a trellis to support the pots: this flue now returns along the back wall.

The best building-materials are the cheapest. Thus, my vinery was built with the finest red bricks, made in the neighbourhood. About 6,000 will be required if the back wall be cellular; and these, at 40s. per thousand, cost 12*l*. Fifteen bushels of strong, recently-burnt lime, and three or four times the quantity of gritty, road sand, will be required at the least; but these can be purchased and carted,—the former at 8*d*. per bushel, the latter for a few shillings.

The timber should comprise *battens*, each two and a-half inches thick, seven inches broad, and twenty or twenty-one feet long. Of these the rafters and wall-plates will be constructed. The quality of the batten is generally very good; the wood is full of turpentine, and therefore durable. The cost, at 4*d*. per foot run, is 6*s*. 8*d*. or 7*s*. For the sashes, the plate on which the rafters rest, the door and frame, *deals* three inches thick are used. They are to be sawed into boards, one, one and a-half, and two inches thick for the frames and bars of the lights; and into “stuff,” four by three, for the jaumbs and wall-plate. A twelve-foot deal costs 6*s*.

The sliding lights will be double, in pairs; the lower range is to be fixed; not, however, by nails or screws, but by wooden stops, made to fall against the front plate. By pushing up the lights a few inches to relieve the stop, each can, as wanted, be slid down and removed. The upper lights, which overlap the rails of the lower range, may all be made to slide, being secured, and the opening regulated by spring catches; or the alternate lights only may slide, the others being secured by strong brass eyes, screwed into the side stiles, to receive pins, that pass into the rafters. By removing a pair of these pins, the light can be taken down without much trouble. In a word, for the convenience of painting and repairs, all should be made moveable without much trouble.

The lights should not be less than a yard, nor more than three feet six inches wide; the bars to be cut out of 1½-inch stuff, an inch thick before planing; the rabates to receive the glass are half an inch deep by one quarter of an inch wide on each side of the mid-rib: this will admit of a sufficient bedding of putty.

Glass is now dear; in 1835, squares, (or, as they are styled, *quarries*), 5½ inches by 3½, might be purchased in Water-lane at 6½*d*. the square

foot, subject to a discount of 10 per cent. for money; subsequently, the price was raised to 7*d.*, then to 9*d.*, or more, without any discount. *Putty* costs about 16*s.* the cwt.; white lead, 5*d.* per pound; and linseed oil about 4*s.* 6*d.* per gallon.

*Painting* ought to be carefully attended to; and the first process, after *knotting*, (that is, covering the knots with a mixture of glue and red lead,) is to prime every part of the wood-work with the following materials:—To each pint of the best linseed-oil, add three ounces of finely levigated litharge. Let it be perfectly ground, and intimately mixed, at first with a small proportion, and then by degrees incorporated with the whole, of the oil.

The *priming* tends to saturate the surface of the wood with an oil, which is rendered drying by its attraction of the oxygen of the litharge; and thus less real paint is required to cover and secure the wood.

The sashes must be primed only, before they are glazed; and when the putty has set and become firm, they may be painted.

All the wood-work within the house, and therefore the inner side of the lights, should be painted *white*,—twice in oil. For the external work a light drab, or stone-colour, is in every respect most appropriate.

In preparing *white paint*, one pound of the best white lead, *ground* in oil, will generally be found to take seven ounces of oil; with these a quarter of an ounce of levigated litharge is to be incorporated as a dryer.

The *stone colour* may be varied in tint according to fancy; but one of good appearance and sound quality is made by grinding together three drachms troy of the best Turkey umber, one drachm of red lead, and a quarter of an ounce or three drachms of litharge, in a sufficient quantity of oil, adding them to a pound of white lead, mixed up as the white paint, with seven ounces of linseed oil.

*Green* is a bad colour for outside work; it harmonizes with no one thing about it, and it possesses few of the qualities which constitute what is called “a body colour.”

Many, if not all, the colours, can be purchased of oilmen or druggists, ground in oil, and of the consistence of white lead. If these be employed, little grinding with the muller and slab will be required; but the quantities and proportions must be regulated by trials.

When a suitable tint is decided upon, the work, after the priming has become thoroughly dry, is to be painted twice; each coat should be laid on evenly, and the covering perfected by labour with the brush and sash-tool, not by daubing with a volume of paint; which, instead of securing the wood, causes smearing and blistering, with much waste.

It must be remembered, that a coat of paint given every autumn repays itself; but two coats should be applied in the painting of the second season.

We have already alluded to the fire-place ; but *that*,—as connected with the flue,—requires the minutest attention. A good draught must be provided for, whether the smoke be retained and pass, or be consumed by the agency of steam. The leading, governing principles of an active flue are the following:—

1st. The *furnace* must be sunk lower than is any part of the flue throughout its course.

2nd. The *neck*,—or that part which connects the fire-place with the proper horizontal flue,—must rise throughout its course ; and the steeper the ascent the greater will be the rush of rarefied air. Perhaps the most certain draught will be secured by contracting the neck gradually ; thus, —suppose the furnace to be, at its base, four feet below the floor of the house and the bottom course of the flue : that the external face of the furnace project one foot beyond that of the back wall of the house : and that the fire-place be one foot above the bottom of the ash-pit, and from eighteen inches to two feet long :—then, from the bottom of the bars to the entrance of the flue, inside, the rise will be three feet ; and if we calculate the breadth of the fire-place at ten inches, and its height above the bars at twelve inches, the neck should be contracted on its four sides, like a reversed hopper ; till, at the distance of about eighteen inches from its exit, its proportions are reduced from twelve inches by ten to eight inches by six. It may then gradually expand till it lose itself in, and become one with, the flue.

The *equable distribution* of heat is of consequence ; therefore I place the furnace of my vinery near the centre of the back wall, and not projecting far from it. In this situation a portion of heat from the fire will circulate among the air-cells of the wall ; while the depth of the fire below the floor will prevent any danger of burning heat ; and the extreme action will be tempered by the length and expansion of the neck.

It is believed by many that the flue of a vinery acts most efficiently, when it is built of two courses, one returning over the other, and situated near the middle of the house throughout its length. In the event of the *combustion of the smoke*, I incline to recommend the adoption of this method. The under course will then receive the force of the fire, and will communicate its great heat to the bottom of the upper course, which returns over it to deliver its vapours into a chimney at the end of the house. If this construction be adopted, the fire-place must be at one end of the back wall, so that the double flue may extend the whole length of the house ; the chimney then will stand close to the furnace.

When two separate courses are preferred, the first receives the neck, leaving it at a right angle, and proceeding, right or left, to one end of the house ; this course is to be built of three bricks laid flat, and covered

with plane tiles; and those, with another course of foot-paving tiles. At the end, the flue will take a turn, and pass nearer to the front wall, leaving a considerable space between itself and the first course to which it will be parallel. After running nearly the entire length of the house, it will take a second turn, and enter the chimney. The second course should be constructed of the same internal dimensions as the first, i. e., nine inches in depth by six in width in the clear; but the sides should be built of two bricks on their edges, and covered with nine-inch paving tiles; each to have an inch and a-half bearing on the courses of the flue.

Every part of the flue must rest upon a flooring of bricks, grouted and bedded in; and its internal surface should be securely pargetted with lime and cow-dung.

The house being finished, the walls and flue should be brushed over with a wash made of the softest mortar, consisting of lime and sharp sand only, beat up with half a pound of flowers of sulphur; adding hot water sufficient to reduce it to the consistence of cream. A little fresh-slaked lime will add whiteness, if that be required. Painting will complete the operations.

I have thus spoken of the erection; but there is one point to which no reference has been made, though it must be attended to before a brick is laid: I allude to the bed which the vines are to grow in, generally styled the vine border. It may happen that the soil of the garden will be exactly suitable; and if so, no fresh material will be required; but if otherwise, all the earth should be removed from the site of the intended erection, and also from an equal extent of ground in front of it. Great depth is not required, but two feet is not too much. Perfect drainage at the bottom is indispensable, and may be provided for by laying the bottom on a gentle slope, and digging a trench along the front a foot deeper, filling it with stones, brickbats, and lumps of chalk, covering the top with flat pieces of slab-stones. If the soil rest upon chalk or gravel, the excavated space need not be paved; but if it be clayey, a four-inch stratum of brickbats, rubbish from lime-kilns, or stones, should be laid entirely over it, and be beaten solid. Upon this foundation, coarse, turfy sods should be placed inverted, then turves of the same loam chopped smaller: among these a liberal supply of coarsely-smashed bones may be distributed. The uppermost soil should consist of sandy, fibrous, loam, abounding with grit, that will never clod, or bind hard, under the influence of rain or sun. If bone-dust be used, it might be introduced in this stratum; I cannot, however, speak of it experimentally.

The bed being formed and settled, the vinery may be erected; its front wall resting upon arches, if required for support, or for the convenience of a water-tank beneath them.

*The vines* to furnish the main crops should be raised in pots of light

soil, by bending into them any fine young rods of approved varieties, at the commencement of the forcing season. If the shoot be fixed firmly in the pot, three or four inches deep, roots will speedily be produced; and whenever the pots become full, the plants may be transferred to the soil of the border within the house. This, however, is a work of preparation, which ought to be foreseen in time. Many persons purchase vines of nurserymen; these are usually single rods, from stools of one year's growth. Sometimes they are rootless; and of this gardeners complain, and not without good reason: for it causes great loss of time, the plants making little progress.

*The vines*, however they be procured, should be planted inside; for, the atmosphere being equable in temperature, the stem becomes excited simultaneously with the branches. If the roots wander externally, the deep covering, applied at the time of forcing, protects them; but it is not so if the collar, and a foot above it, be subjected to *cold*, while a high temperature is in full activity within.

*Objects of forcing*.—These are multiform. Some persons affect an early crop of grapes, to be ripe in March; and the time *has been* when 3/, or more, could be obtained for a single pound of the finest black grapes at that early season. It is worthy of notice that in the year 1838, in March, the best black Hamburgh grapes were sold, in Covent Garden, at 1s. 6d. or 2s. per pound. Such is now the effect of free, foreign intercourse. Very early forcing becomes, therefore, valueless; and as the process is not only extremely expensive, but injurious to the vines in consequence of the great excitation employed at an unnatural season, the sooner it is relinquished the better.

The period of pecuniary remuneration, if it now merit that term at all, is restricted to the month of May, when we find the price quoted at Covent Garden to have been from 12s. to 8s. per pound, for the best black Hamburghs; all other varieties, including those with musky flavour, as the Frotignacs, being of no power at all in the market.

Among the *black grapes* for domestic culture, however, we may safely include three noble vines, now to be alluded to: namely,—First. The Frankendale, or Frankenthal, thus described at No. 18 of George Lindley's Catalogue in his *Guide to the Orchard, &c.*, p. 197. “*Bunches* tolerably large, with small handsome shoulders, a little resembling the black Hamburgh. *Berries* somewhat oval, but flattened at the head, where it is much broader than at the stalk; and when fully ripe they are indented on the sides, as if by pressure of the finger and thumb. *Skin* deep purple, approaching to black, covered with a thin bloom. *Flesh* tender. *Juice* sweet, rich, and of excellent flavour.” The tree is not dissimilar to the Hamburgh, but its habit appears to be more slender and delicate. *This I have proved by inarching Frankendale and Hamburgh green shoots,*

in 1837, upon Hamburg and white Frontignan stocks, growing in one bed, and starting into action at the same period in 1838. The Frankendale rods were invariably of less vigorous growth than their competitors, the Hamburg. This comparatively slender growth may be very aptly expressed by the botanical term '*gracilis*.'

Second. The true black *Hamburg* first brought into England by Mr. Warner, of Rotherhithe, in 1724. "A great bearer, always perfect, and regularly formed."—LINDLEY, 193. Fashion and fancy have also stamped the character of this variety, and pronounced it the "*sine qua non*."

Third. The *West's St. Peter's*,—that variety described by Mr. Oldacre. Its characteristic marks are, a purplish tint of the half-ripe wood and footstalks of the leaves. The foliage is glossy on the under side; of a rich full green on the upper side; each leaf being irregularly divided into five lobes, and not deeply toothed.

These three vines will furnish the vinery. Some definite plan must be laid down and acted upon, according to the views of the proprietor. The one I shall describe particularly, embraces a double object. The *first* is to obtain a moderately early crop from twenty or more vines growing in pots, and from four vines planted in the bed within the house. The *second* is to obtain a late crop from two vines, planted in the exterior border, one at each of its ends. The *West's St. Peter's* is impatient of early forcing; but if excited about the middle of April, and carried through its first stages by steady heat, till the grapes become the size of peas, an admirable crop may be expected. I saw in the summer of 1838, upon a young vine, occupying not more than two lights of a vinery, 200 bunches of very fine and promising clusters. The berry when ripe is of intense purple, the skin is extremely delicate, the pulp luscious, abounding with saccharine juice, though not highly flavoured. This vine, therefore, is exactly suitable to the object. It should be exposed to the open air, and thus retarded till the period of late forcing, though duly protected from *severe* frost by matting; because we have been instructed by the winter of 1838, that, when the mercury descends from two to six degrees below zero, vines may be killed to the ground by extreme frost, attended with alternations of hot sun.

In forming our six vines from the rooted layers, it will be advisable to plant the Hamburgs and Frankendales at equal distances, near the back wall, as soon as they have filled their pots with a ball of roots; being careful to separate and extend the fibres, spreading them out in all directions, at a depth below the surface very little exceeding that of the pot. Upon the roots a layer of leaf-screenings, mixed with one-third of washed road-sand, may be laid; and over that two or three inches of the earth. Water in abundance should be poured over the soil above the root; and, finally, the ground about the stems must be levelled. It

is probable that the trees will not grow much during the season; but if they be healthy, and skilfully planted, they will not fail to make way underground, and should be cut back, at the fall of the leaf, to the two lowest, prominent eyes, above the surface. The cut is to be made in a slope, corresponding with that of the uppermost bud, but an inch and a half above it. These directions will equally apply to the two West's St. Peter's; with this difference only, that they are to be planted in the outer border, the stems being introduced through an opening in the front or side wall, near the corners, to which a stout board and frame is adapted.

The vines must be cut down in autumn at a point that will permit the introduction of the stems at the season of forcing; and then a notch being made in each of the boards, at the part where the stems enter, they are to be fitted to their frames and secured by turn-buttons. As the notches will be somewhat wider than the stems, a bandage of moss should be applied, to close the openings, and prevent the abrasion of the bark.

Vines raised from strong shoots, skilfully planted, and cut down once before the sap is in motion, will not require to be so treated a second time. From the two eyes it is probable that two shoots will be produced; these must be permitted to grow till it is seen which will be the stronger; and in the mean time the shoot will acquire some firmness of texture, and lose that extreme tenderness which renders it liable to be injured by the slightest degree of force. The stronger of the shoots should be selected, and the other removed; it will grow rapidly, and may attain twenty feet in length, and a diameter of full half an inch, in the first season. When the wood shall become firm, the stump left can be cut back, in a sloping direction, close to the new shoot, and the wound will heal perfectly.

If the vines break weakly, and the shoots be proportionately slender, another year must be allowed, and the vines cut back again. Whenever strength of stem, and prominent, close-set eyes are attained, the shoot may be permitted to grow till it become slender at the apex; then, it should be stopped, by pinching off the extreme point. This operation will give substance to the entire rod, and cause all the buds to enlarge. Lateral shoots will be developed, which should be cut back in succession, to their lowest bud, as they attain three joints. In this way, all laterals should be treated at all times; claspers or tendrils being removed as they appear. After a first stopping, the foremost *secondary* shoot will assume the character of a leader; and it will be more prudent to permit it so to do, than to force the *main* eye of the rod to break by repeatedly stopping the advancing *secondary*; because *that eye* may become a fruitful bud in the event of the rod growing very strong throughout its entire length. The stopping of the bud should be repeated two or three times, if the growth be rapid; every check so produced will be beneficial, and tend to

accelerate the maturing of the wood. At the approach of winter, the rod must be pruned back to within two inches of a prominent ripe bud, and the vines be exposed to the influence of the air by removing the lights, or by keeping them open, day and night, till the frost set in. Two or three degrees will do no injury; but vines, under glass, should not be exposed to a greater depression of temperature.

As our vinery may be employed for a variety of purposes, according to the taste of the owner, we must presume that some will attempt the culture of the vine in pots, while others will combine with that, the horizontal order of training the vines planted in the borders. The following method of horizontal training is described in the *Horticultural Transactions*: it displays much scientific combination—I give it nearly entire, as I find it in the *Encyclopædia of Gardening*, at p. 546, edit. 1826. The statement was presented by J. Seton, Esq., of Stamford Hill, after being proved successful during the course of several years.

“The vine having, like other trees, a tendency to produce *its most vigorous shoots at the extremities of the branches*, and particularly at those which are situated highest, it generally happens when it is trained, as is most frequently done, across and upwards, from the front to the back of the house, that the greater portion of the fruit is borne near the top, while the lower parts are comparatively barren. This takes place whether the branches be made to consist chiefly of vigorous terminal shoots, preserved at considerable length, or the leading shoots be kept short, and lateral spurs be left for the production of the fruit; but in the latter case the evil exists in a smaller degree, for the spurs, or short lateral branches, divert the sap in its ascent, producing, by means of its flowing to their extremities, an approximation to the effect of large branches. Having observed that the fruit produced on the vigorous shoots which usually grow at the extremities of the long branches, is generally more abundant, and of a finer quality than that produced on the short lateral ones, I was desirous to promote the growth and preservation of the former; but the usual mode of training the branches across and upwards, being subject to the objection before mentioned, and little scope being afforded for it in a house of small dimensions, I thought I should obviate these inconveniences, in great part, and attain another object presently to be mentioned, by training the branches in a horizontal direction, and keeping the whole of the fruit-bearing part of each tree nearly at the same level.

“Five vines were planted at the ends of a house twenty-five feet in length, for this purpose provided with rods placed horizontally under the glass of the roof twenty inches asunder, and extending from end to end. The first vine placed at one end, being trained up to the two lower rods, a shoot of it was laid along each of them, and continued successively from

year to year till it reached the other end; and then the shoot on the *lower rod* was turned upwards to the next, and led back upon it towards the stem of the tree, while that on the *upper rod* was turned down and led back in like manner on the lower one. During this process a sufficient number of spurs, or short branches, was left annually on the old wood to produce fruit. When the leading shoots, which had been thus trained in a retrograde direction, approached towards the end whence the original branches proceeded, preparation was made for a succession of young wood, bringing forward two fresh shoots from the stem of the tree, and leading them along close to the preceding ones. As these, and the leading shoots of the first branches which were then on their return, advanced, the *spurs on that part of the old wood to which they had reached* were cut out to make room for them, the naked stem only being left. When the second series of branches had returned nearly to the end at which the trunk was situated, the first series, on which there was but little of the herbage remaining, was cut out at the trunk. Fresh shoots were then brought forward to succeed the second series, and so on without end.

“Thus in a house of twenty-five feet in length, instead of only fifteen or sixteen feet to admit of the length of a branch, we have a range of thirty feet, which affords ample scope for the long shoots at the extremities; and these, I find, when laid on in the horizontal position, and left from three to five feet long, according to their strength, usually bear fruit at all their buds, while the spurs on the old wood are also very productive.”

The equalization of growth and of temperature is the object of Mr. Seton's mode of training,—“but,” he adds, “whatever may be the effect produced by the horizontality of the position in equalizing the luxuriance of growth, I conceive that no doubt will be entertained in regard to that of a uniformity of temperature, and this is fully obtained by the method in question.

“In the usual mode of management each tree is under the influence, in its different parts, of all the degrees of temperature in the house; but under the mode now proposed each tree has its own peculiar climate, to which alone all its parts are exposed. This affords us the command of a most convenient variety in regard to earliness of ripening fruit. For example, if there be a wish to save fuel, and yet to have grapes of several varieties which ripen at different seasons, *of the late sorts* there will, under the common method, be only a few bunches brought to perfection at the tops of the trees, while those that are near the bottom will not ripen, and that part of those trees will accordingly be useless. But in the arrangement above described, the early and late sorts may be procured at the same time in equal abundance and perfection, by training the early sorts—let us suppose the sweetwater at the bottom; the middling ones,

such as the black Hambro', next; and the late, such as the muscat of Alexandria at the top.

"Again, if it be wished to have some very early, and others very late, the order may be reversed by placing the early varieties at the top, and the late at the bottom; in which case more fuel will be required."—(From *Hort. Trans.* Vol. iii. p. 9—13.

Such was Mr. Seton's method, from which much information may be derived. I think I perceive something rather fanciful in the last lines, but the rationale of horizontal training is, upon the whole, ably sustained. The chief objection to the *precise method*, is the crowding of the shoots: this points out, what I conceive will be found an improvement,—the propriety of training the first branches to wires, two feet apart at the least, and to lead the returning shoots along two other intermediate wires. The new successional shoots may then, with greater safety, be laid close to the old branches, which being deprived of their spurs, cannot injure, or be injured by the foliage of the advancing shoots. To carry on the plan to any available extent, the breadth of the house should be considerable; and the flues ought to be so constructed as to command the house completely, and produce a very equable degree of temperature.

So much has been said already upon the training of the vine in DECEMBER, Section III., that it will be needless to insist further upon that subject in this place. The vines of the borders which furnish the crops on the rafters must ever be considered the chief furniture of the vinery.

POT CULTURE is a secondary, though very praise-worthy object, and one which may procure extreme gratification to the zealous amateur. It is astonishing to what perfection fruit is brought by this method, if skillfully pursued; but it cannot be concealed that much trouble will attend it, and that the most unremitting care may be baffled by a trifling oversight.

The world is indebted to Mr. Stafford, gardener to Mr. Arkwright of Willersley, for the best series of directions on this mode of cultivating the vine, and to these, as published in the late *Horticultural Register*, I shall chiefly recur,—referring likewise to Mr. Stafford's letters to me, for particulars which do not appear in print. The preparation of the vines is the first essential to be noticed; for in order to have good fruit of the best kinds, the plants must be renewed yearly. It is true that the *Verdelha*, and some few of the inferior, small-fruited varieties, have been known to produce three, or more, successive crops; but the Hamburgs, Frankendales and purple Constantias, cannot be trusted after the first year. And as I limit my choice to these superior sorts, I must give them every advantage which their habits require.

*The raising of the plants* claims the first notice,—and hereupon

authorities differ ; some contending that fruit-bearing vines may be prepared in one season from the bud, while others require two years of preparation to bring them to a due state of maturity. A cutting of a fertile vine, *proved to be such*, with three buds of the wood of the last season, having a small piece of two years' wood at the base, taken in January, placed in a pot of rich sandy earth upon a hot-bed with a lively moist heat, will speedily furnish roots, and frequently send up one strong shoot ; which, if encouraged by repeated shiftings, as the roots fill the pot and appear at the bottom, may, by the time that it is established in a pot twelve inches deep, have attained the length of ten feet, and be furnished with bold and prominent eyes, not more than five inches asunder. Such a vine may bear twelve or more bunches in the second season, provided it be trained near a light of the vinery during its growth, and mature its wood perfectly ; but though large it is still an infant, and at the best is an exception of rare occurrence.

Mr. Stafford's method of raising vines for potting is, upon the whole, to be preferred. He places a number of cuttings, perhaps twenty or more, in a pot of light vegetable mould, early in March or April ; strikes them, and is contented if they emit numerous roots. At the end of the season each plant may not be a foot high, nor thicker in the stem than a small goose-quill. I have received a dozen vines from him at one time, not any of which has materially exceeded the size described. His directions, given in the *Horticultural Register*, are to the following effect :—  
 “ I take a plant in March, raised the preceding year ; head it down, and put it in one of the pots I recommended.” These are in size thirteen inches wide at the top, inside measure, tapering to about half the width at the bottom, and about fifteen inches deep. “ The soil I make use of is light, rich, vegetable mould.”

This mould, I learn from Mr. Stafford, is procured from the weeds of the garden, reduced to a black earth by fermentation in mass. It, of course, partakes of the nature of the soil of the garden, not only because weeds deposit earth similar to that on which they grew, but also because more or less of the soil adhering to the roots is raked off, and carried with the weeds to the heap.

The plant when potted “ is placed upon the front flue of the vinery, and the strongest shoot selected, which is trained to the length of five feet betwixt the vines on the rafters ; and every attention is paid to give the leaves an opportunity of expanding, and presenting their proper surface to the light. I allow the side-shoots to grow, occasionally stopping them through the season.”

On this point Mr. Stafford observes, in a letter :—“ Let the vine be trained to the length of five feet ; at this length, stop it through the season, giving every encouragement to the laterals till they have grown

for a fortnight at least, then stopping, but allowing three or four joints to each axillary shoot." Thus, strength of wood is acquired, and the eyes are more likely to become bold and fruitful, than if the lead had been permitted to run on, diminishing in size till it became of little more breadth than packthread.

"When the wood is ripe, the plants are exposed to the open air until the season for introducing them to the house again. The pots are placed under the garden-wall, and the shoots nailed up to it; they are protected from frosts by a little long litter being laid over the pots."

The winter of 1838 taught us caution. I exposed my potted Hamburgs, Frankendales, Muscats, &c., till the severity warned me to have them removed to a shed under a thatched roof. I found, however, on gradually exciting the plants, long after the thaw had set in, that every root had been paralyzed, more or less; and though only six plants (Muscadines) were killed, not one of my stock made way. All the plants had a complete system of roots to re-form, and those which supported fruit, could not bring the crop forward. The bunches were feeble, and the berries small. If, therefore, the frosts become steady, and the mercury recede below  $28^{\circ}$ , ( $4^{\circ}$  of frost,) the pots should be brought into the vinery, placed over the flue, and the stems trained horizontally, till the season of forcing arrive.

Thus far concerns the preparation of the vines; and these, if they afford a promise of proving fertile, will conform to the following description by Mr. Stafford:—

"The number of buds will be regulated by the treatment, in a great degree; if plenty of air and light is admitted, the shoots will, of course, make less progress, and a greater number of buds will be produced in a given length. I have observed from eighteen to twenty-four buds in the length of five feet."

"I never use liquid manure, except in a diluted state, and this but seldom. I pay particular attention to the supply of pure water, twice a day, and never allow this to be the work of two persons."

The finest house of potted vines I ever inspected is at Great Missenden. It was regulated by the gardener himself, Mr. Begbie, who had, perhaps, followed closely the system of stopping taught by Mr. Mearns, late of Welbeck. The plants were seven or eight feet long, wood half an inch in diameter, and they were not permitted to bring to maturity more than nine clusters each. The soil used was a turfy, light loam, from a sheep-down, enriched by a portion of linings' manure. Water was always given till it flowed through the drainage. But an improvement might certainly be found in employing double pots; the outer one to be joined or cemented to the bottom of the inner one, so as to leave only the holes open. Thus, wet moss, or water, could be applied all around, without obstructing the drainage of the inner pot.

This adaptation of two pots would obviate the retention of water among the roots, and the scorching heat which rises from the flue ; but the pots would be found very cumbersome, and, if purchased, expensive.

The shoots of the vines are stopped above the fruit, the fruit thinned, and supported according to the usual practice ; but Mr. Begbie appeared to leave three entire joints above the upper cluster of *two*, and the heat maintained *by fire* he thought should amount to 65°. At this point he closed the house at night ; and, commencing to force about the middle of January, produced hundreds of superior bunches in May.

The plan is one of beauty and ingenuity, but it requires rigid attention, and is subject to many contingencies.

It will be advisable always to provide a yearly supply of plants ; though I have seen excellent fruit upon some vines which had produced two or more successive crops.

A due regard to moisture must be paid ; otherwise the red spider, (*acarus*,) will prevail. The flue may be sprinkled about sun-set, and the ground copiously watered to raise a certain degree of vapour ; and the ground-watering can be repeated early in the morning ; but those profuse steamings, too often persisted in, need not be adopted. Sprinkling is the best remedy if the spider appear ; but it must not be practised while the vines are in flower, and both steaming and sprinkling are generally relinquished altogether when the fruit begins to ripen.

### THE STRAWBERRY.

The variety of this delicious fruit that is peculiarly adapted to the forcing-house, is *Keen's seedling*.

It is early, a free bearer, productive of large berries, of tolerably good flavour. It is not identical with Keen's imperial, which is rarely seen in collections. The directions for preparing the strawberry, for forcing in pots, under the head *Propagation*, No. 591 \*, are to be very strictly attended to in the first instance. I shall presume that the plants have established themselves in their first pots, and filled them with roots. This they will have done by the end of August. At that time a number of the pots termed *broad thirty-tvos*, or, in their place, others called *twenty-fours*, should be prepared in the following manner :—Collect a quantity of broken pots, the pieces to be from half an inch to an inch square ; place a small oyster-shell, or a flat crock, over the hole of the pot, and over that an inch layer of the drainage ; upon which lay a little moss. Chop some rich turfy loam very small, and mix it intimately, either with one-third part of decayed leafy compost from the hot-beds or

\* See Strawberry, Sec. III., October, page 480.

linings of forcing-pits, or an equal quantity of half-reduced sheep-dung. Place some of the soil upon the moss ; turn the strawberry plants, one by one, with their balls entire, out of the small pots, and deposit one plant in the centre of each large one, upon the soil : and so deeply as to permit the addition of at least half an inch of the new soil above that of the ball. Collect the leaves of the plant with the left hand, and with the right put the new soil around the ball, striking the pot now and then on the potting-bench, and with the fingers pressing the earth equally about the fibres of the roots. In this way fill the pot to within three-quarters of an inch of the rim. Then soak the soil completely with rain, or soft pond-water ; and when the potting is completed, place the collection under a north wall, upon tiles, or a deep bed of ashes, to prevent the ingress of worms. In this shady situation the plants are to remain, and be freely watered, if rain do not suffice to keep the soil moist, till the first week of October. They are then to be removed to an open exposure, where the forenoon sun can have full power over them, till the time of forcing arrive. If frost of severe character occur, the pots may be surrounded with a deep bed of leaves, or be plunged in ashes to prevent them from being broken. If the variety be true, the plants skilfully selected, and the treatment judicious, the eye of the plant will appear large and full. The results of such preparation will be a fine display of bloom and handsome fruit. Under ordinary and, I may call it, careless preparation, from ten to fifteen strawberries, of medium and small size, may be the average result ; but from forty to sixty large and medium berries have been seen upon one fine and duly prepared plant.

*As to the time and manner of forcing* in the vinery, something must depend upon the object of the proprietor. I should choose the middle of February for the introduction of the plants. At that time remove all discoloured or inert leaves ; take off the surface of the soil in each pot ; apply a top dressing of fresh-manured earth ; give a thorough watering ; and, having washed the pots, place them in a trough-like shelf, close together, near the glass, having previously put an inch layer of fine road sand at the bottom of the shelf.

*Temperature and Water.*—Fifty-five degrees by fire are sufficient, but the plants will be necessarily exposed to a greater heat. Air, therefore, will be required ; and this, prudently given by the sliding lights, will not injure the grape-vines.

Water is required in abundance, so as to keep the soil nearly saturated. The drainage in the pots will carry off any superfluous water, and the sand will receive it ; thus accidents will be obviated, and, in all probability, a very great crop of fruit produced to reward the assiduous attention of the cultivator.

These strawberry plants may continue to bear forcing for several suc-

cessive years ; all that is required is to shake off all the soil, to cut away the black and inert roots, and to plant three in a twenty-four-sized pot, using the rich compost before directed. The season for this preparation will be the second week of August, and the autumnal treatment will be the same as that of the fresh plants already described : success is doubtful.

If great frost threaten, it would be a safe practice to afford the protection of a glazed pit, plunging the pots in leaves till the season of forcing come round.

### THE CUCUMBER.

The common, or garden cucumber, is a native of the East Indies, and appears to have been introduced to England in the year 1573. *Cucumis* is one among ten or eleven other genera, which are contained in the natural order *Curcubitaceæ*, or the gourd tribe. This consists chiefly of climbing, succulent vegetables, mostly annuals. Some possess very acrid and bitter qualities, of which the cucumber partakes when it approaches to maturity.

*Cucumis*, in the system of Linnæus, is referred to Class xxi., Order viii., *Monœcia Monadelphica*. It has the male and female blossoms, produced apart, on the same plant ; and this is implied by the classic term, it being compounded of two words, *monos*, one, and *oikos*, a house. The male organs consist of three filaments, united together, and thus forming one body. The word *monadelphia*, is derived from *monos*, one, and *adelphos*, a brother. The male blossoms have a calyx of five teeth, and a corolla, five-parted ; filaments of the stamens, three, united at the base ; anthers, three. The female flowers have also a five-toothed calyx, and a five-parted corolla.

The cucumber is a tender plant ; it will grow and thrive in the open ground during the three summer months, if the weather be genial ; and is thus cultivated largely, over manured ridges, by cottagers and market-gardeners. But it is subject to many casualties, and is frequently destroyed by frost at a critical moment, when the labouring gardener had anticipated an ample supply and a profitable return.

I therefore consider the cucumber as a plant which requires protection at the least. But as most persons might desire to have a supply of the fruit throughout the summer for the table, and in the autumn as girkins for *pickling*, a method of growing the plant will be detailed, which can scarcely fail to realize the hopes of the gardener, while it almost entirely obviates the risk which generally attends the progress of the cucumber-plants, when fully exposed to the open air.

Prepare a piece of ground early in May, enough for a large three or four-light frame ; dig it over thoroughly to the depth of nine inches, and incorporate with the soil an equal portion of light vegetable turfy earth,

or pure leaf-mould. This will raise the bed ; then bank it all round with turf, the grass surface downward. And thus the prepared soil will be retained within its limits, and be duly protected. In the mean time the plants should be raised from seeds sown in very small pots, of light, rich earth, upon a gentle hot-bed, or in some forcing-house. They will soon be up at this season of the year. Every pot should be netted with hay or moss, and the seed placed about half an inch below the surface. When the plants have filled the first pots with roots, they are to be removed to others, about four inches wide at the top. The hay in the first pot serves to keep the ball compact, and facilitates its removal to the larger pot without any disturbance of the roots.

It will be prudent to retain the plants in a gentle heat, not exceeding 60°, till they recover from their removal, and begin to grow freely ; they may then be taken to a green-house for two or three days, or to the bed, where they are to remain.

Much has been said and written upon the necessity of stopping,—that is, pinching out the little central bud which appears between the two first rough or true leaves, that are found immediately above the *cotyledons*, or seed-leaves. It is undeniable that, by arresting the central growth, or leading shoot, other lateral buds are excited ; and thus those buds which lie concealed, and contain the embryo fruit, are soon brought to light. A shoot which would extend more than a yard without showing fruit, if stopped above the second lower joint, by pinching out the bud as soon as it became visible, will so, for a time, be checked ; and then two lateral shoots will be protruded from buds which would have remained dormant. These shoots may be correctly styled *secondaries* ; and if they be stopped at their third joint, then other shoots,—laterals to the *secondaries*,—which will soon proceed from those, will speedily develop fruit. Keeping this habit of the plant in view, the following remarks, taken from the works of Nicol and M'Phael, both celebrated gardeners of their day, will be very useful and to the purpose. The former observes :—“ *Cucumber plants* will put out runners, or vines, whether the heart-buds be picked out or not, which is a matter of trivial concern, although much insisted on by some as being necessary to their doing so at all. For my part I never could discern any difference ; and I frequently made the comparison in the same bed, which otherwise, of course, could not be fair. When the vines have grown to the length of four or five joints, and fruit appears on them, they may be stopped at one joint above the fruit ; but otherwise they may be allowed to run to the length of seven or eight joints, and may then be stopped ; which will generally cause them to push fertile shoots. These should be regularly spread out, and trained at the distance of eight or ten inches apart.”

M'Phael stops at the *second* joint:—"When the plants shoot forth again after the second stopping," above the second joint of the first produced laterals, "they seldom miss to show fruit at every joint, and also a tendril; and *between this tendril and the showing fruit*, there may be clearly seen the rudiment of *another shoot*." This shoot is in embryo; if developed, it becomes a fruitful lateral. "And when the leading shoot has extended itself fairly past the showing fruit, then, with the finger and thumb to pinch it," the *leader*, "and the tendril off just before the showing fruit; being careful that in pinching off the tendril and the shoot, the showing fruit be not injured. This stopping of the leading shoot stops the juices of the plant, and enables the next shoot," the rudiment above mentioned, "to push vigorously; and the fruit thereby also receives benefit.

"When the plants are *come into bearing*, if the vines be suffered to make *two joints* before they are stopped, at the *first* of these joints, as I have before said, will be seen a showing fruit, a tendril, and the rudiment of a shoot; but at the *second* joint there is seldom to be seen either showing fruit, or the rudiment of a shoot, but only a tendril, a cluster of male blossoms, or leaves, which would serve no good purpose."

I have retained the entire sense of the quotation, but have ventured to take a trifling liberty with the wording, in order to render the author's meaning perspicuous, and free from ambiguity. The observations are clear, manifestly experimental, and have led to the practice of the best growers. Nothing need be added further than the caution to look for the embryo shoot, which is so small that it might easily be passed over by the young gardener. Were the old leader to be suffered to go on, this rudiment would most likely remain dormant, and thus fertility be retarded or diminished. If, then, fruit can be obtained in quick succession by no other means than by stopping the lead at the embryo cucumber, and thus forcing out a new or lateral shoot at the axis of the very joint which bears a fruit,—then it becomes an object of great moment to let the plant acquire constitutional strength before this rigorous stopping be resorted to; and as the cucumber is naturally a climber, it appears to me essential that a mode of culture be adopted which can combine length of stem with very great extent of foliage; and this, indeed, has become the practice in many gardens.

*Planting.*—During the preparation of the plants the bed of earth ought to be protected by a frame, with lights adapted to it, which have a slope towards the south, at an angle of about  $15^{\circ}$  with the horizon. This will be obtained if a frame be six feet wide at the back, two feet six inches deep, and one foot only at the front. The lights ought to be kept on the frame night and day; observing to tilt them during the height of the sun, in order to warm and dry the earth of the bed. We will now

suppose that, by the 1st of June, six fine cucumber-plants are ready, and the earth within the frame raised to a genial temperature ; rather moist, but perfectly free and open, insomuch that it will pulverize freely under the hand. This bed is covered with a three-light frame, each light being three feet four inches in breadth.

In the first place draw a little of the earth together, exactly under the centre of each light, and form a sort of flat hill or ridge, a foot wide, and raised about three inches above the common level. Thus there will be three elevated masses of earth within the frame. Turn out two plants, by striking the rims of the pots gently against the edge of the frame, and protecting the balls with the fingers. Form two holes large enough to admit the entire balls, and so deep as to let the stems sink an inch below the surface of the earth. Two plants are to be set in each space, six inches asunder, in a line from the back to the front of the frame. Draw earth round the balls ; work and press it carefully and compactly with the fingers, without disturbing the ball of roots. Give water, (the chill off,) over the surface of the hill, but not over the plant ; and in quantity sufficient to reach to the depth of the roots. One hill being planted, proceed in the same manner to plant the two other hills. Then close the lights ; shade with a mat during the power of the sun ; and cover the beds with double mats, secured by boards, or with single mats, and a set of boards over the entire surface of glass.

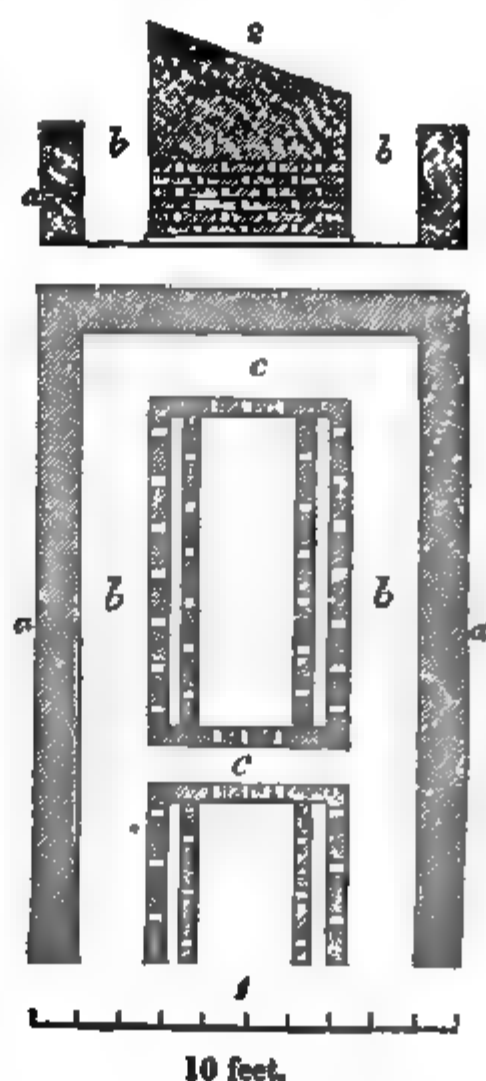
Nothing forms so effectual a covering as good three-quarter-inch pine boards, saturated with coal tar ; a common plank, three inches thick, eleven inches wide, and about six feet long, will cut up into four boards, and cost about 4s. Being tarred, they remain sound during many years ; and to prevent accidents from wind, nothing more is required than to fasten and stretch a cord tightly across the boards, lengthways of the frame, or pit, about two feet from the back of it. Two cords would, of course, afford increased protection.

*Stopping.*—At this genial season the plants will thrive rapidly ; they may be stopped, for the first time, at the second joint, above the seed leaves, or be permitted to produce four clear joints before the central bud be pinched off. Strength of plant will soon be gained ; and after a second stopping, at two or three joints beyond the origin of each lateral or secondary shoot, fruit will be yielded in abundance. A re-practice of stopping just above every fruit might prove most productive ; but in this summer process of mere protection it needs not be insisted on. Free admission of air during bright sunshine, water around the hills, but not close to the stems or over the leaves, and warm covering after sunset, till the summer-night temperature be established,—will secure the health and rapid progress of the plants. Decaying leaves and weakly shoots should be removed ; the vines, if they extend beyond the limited space, must be

cut back ; and if the plants be infested with *aphis* or *thrips*, a thorough fumigation of tobacco smoke must be given.

*Forcing.*—The experienced gardener will perceive that this protective system may be converted into a process of forcing, if a hot-bed and linings be applied ; but I do not favour the method of raising the cucumber by means of a dung-bed. In lieu of it I shall refer to the practice of a very able gardener, as I find it detailed in the tenth volume of the *Gardener's Magazine* ; and I have pleasure in thus evincing the respect I entertain for his skill and ability, of which I have witnessed many proofs.

*Forcing in brick pigeon-holed pits.*—The plan exhibits portions of a range, which may have any number of lights:—*aa* are nine-inch walls,



which surround the pits and the spaces *bb*, designed to receive the linings of hot stable-dung. These walls, as seen in the section (2), are three feet high ; the spaces, *b*, are two feet wide. The pits are furnished with double walls ; the outside wall is of four-inch brick-work, pigeon-holed all round to the height of five courses from the base, (see section 2). The inner walls are built brick on edge, worked solid, excepting one row of pigeon-holes, at the bottom course, left for drainage. This inner wall must be brought up one course higher than the pigeon-holes in the four-inch, or

outer wall; and by covering the cavity between this and the outer wall with a double layer of plain six-inch tiles, it forms a flue, back and front. The plane tiles require to be double, because the centre of each tile which finishes the flue must be firmly bedded in mortar, over the joints of those first laid: this is essential, as the flues must be steam-tight. By means of this arrangement "the violent bottom-heat from the linings, which is the bane of all forcing, is moderated; and, as much of the heat is transmitted through the tiles, it diffuses a mild and genial warmth, which is circulated among the plants, without incurring any danger of too much heat among the roots."

The centre of the pits is filled entirely with mould, as high as the flues, except about six inches of fresh turf, chopped to pieces with the spade, to be put into the bottom for drainage. In warm weather the linings need not be higher than the outer walls, but in very cold weather they should be kept up nearly to the level of the lights, and then be covered with dry straw or fern. Between every set of lights, three being a set, there is an open space, twelve to fifteen inches wide. The dung in these openings, (c,) when once put in, is not to be turned like that of the linings; for as the walls are pigeon-holed, but without flues at the ends, the roots will work through, and receive much nourishment from the dung in the openings, when it is decayed. These alleys are likewise serviceable in cold or damp weather, as they afford the opportunity of topping up all round with fresh dung.

This is an abbreviation of an article upon the culture of the cucumber by Mr. Patrick, (*Gardeners' Magazine*, vol. x. p. 386.) I know the range of pits, which, though narrow, are extremely efficient and commodious, not only for the forcing of cucumbers, but of the Persian melon and pine-apple. I shall advert to it in the notice of the pine; but now need only observe that the pits, when used for the cucumber or melon, are furnished with a trellis; upon which the vines of the plants expand themselves from one long central stem, exposing their foliage and fruit to the sun, not far below the glass. Thus, much danger from damp and the attacks of vermin is obviated.

By stopping and treating the plants according to the direction of M'Phael, the finest fruit may be procured in ample abundance. The seeds should be sown in August and September if cucumbers be required in March and April, and thence later, according to the time when fruit is wanted, till the season arrive for adopting the protective culture first described.

*Culture in the Stove.*—They who have perused the article on the culture of the cucumber in pots by Mr. Aiton, of the Royal Gardens, will not hesitate to admit the feasibility of the method which will now be described as concisely as may be consistent with perspicuity.

It will not be too much to assert that the cucumber can be grown, in great perfection, either in the pine-stove, or in pits and small houses erected for the express purpose. Mr. Knight's Persian melon-house is well adapted to the purpose; and this will, in due place, be described and figured.

In the Royal Gardens, Mr. Aiton tells us that cucumbers were required throughout the winter: the seeds were "sowed on the 12th and 20th of August, and raised on a well-prepared one-light hot-bed. When the seed-leaves became nearly of full growth the plants were potted out, two into each pot, known by the name of *upright thirty-tvos*. When these pots became filled with roots, the plants were again shifted into sixteens, and removed from the seed-bed into a three-light frame, with a sufficient bottom-heat to allow a considerable portion of air to be given day and night. Finally, they were removed to pots containing three pecks of earth, and transferred to the stove in September."

I propose to modify this plan, and to apply it exclusively to spring culture.

Let the seeds of any prolific cucumber be sown in January, and treated in the way already described; only at each potting the plants should be placed deep, and the stems moulded up gradually; not in the first instance, but when the roots are seen creeping on the surface. Three removes will thus bring the plants into their fruiting-pots.

I inspected a set of plants in May, 1836, which then had been in full bearing three months, and continued to produce in regular succession. They were growing in a pine-slip, in pots from twelve to fourteen inches wide at top, and of about the same depth. One set of them was ranged on the back curb of the pit; another on a strong shelf, fixed against the wall of the house; both ranged about thirty inches below the glass. The plants were short and stocky, being closely stopped. Each supported two cucumbers; one of a size for cutting, another small and just swelling. This order was provided for as nearly as possible, and by it the powers of the plant were not too severely tasked.

In my experiments I have employed pots sixteen inches deep by twelve wide; and these I have plunged to half their depth in a trough of mould, eighteen inches deep, training the stems perpendicularly four feet, till they reached a wire trellis ten inches below the glass; at which the plants were stopped the second time, to produce fruiting shoots for training horizontally upon the wires.

*Soil.*—None can exceed the reduced roots of couch-grass, collected from fields of light but mellow loam, and kept for four or five years. Mr. Aiton's soil, used at Kew, consisted of light loam, "a few months from the common," *one-third part*; of the best rotten dung, *one-third*; of leaf mould and heath soil, equal parts, making together *one-third part*.

*Stopping.*—If there be sufficient height, the plants may grow a yard or more before they are stopped to produce a single stem ; but if there be little height, and a trough be not employed, early stopping, to form short, stocky plants, should be adopted. By whatever method fruit is developed, M'Phael's directions for the subsequent management of the shoots should be kept in view. I have thus brought from four to seven fine fruit to perfection on one plant, trained on the trellis of the stove ; but short plants must be restricted to two fruits, one under the other, as before shown. I have tried the power of my plants to the utmost, making extent of growth and profusion of foliage to supply an increased number of fruit ; but in ordinary practice, wherein the plants will be trained upright to a trellis, the laterals produced by stopping the main shoot, being led horizontally, the fruitful shoots are to be securely fastened by twisted shreds of moistened bass. The advancing fruit may then be allowed to hang by its footstalk, without any constraint. One only should take the lead ; and with the increasing power of the sun, a moderate supply of moisture, and a free admission of air during the greatest power of the sun, it will make rapid progress. When one fruit is cut, a second will enlarge, and in the mean time another may be permitted to advance ; thus keeping up a regular succession. Perhaps three or four fruit may show at the same time ; but two only should be left on, and the others pinched off, and with them the leading buds ; leaving the embryo shoots to become fruit-bearing laterals.

If there be no head-room, the plants must be rendered bushy, and be tied to stakes fastened round the sides of the pots.

It is astonishing what an immense quantity of fruit will be yielded by the plants thus prepared, provided the supply of heat, air, sunlight, and water, be apportioned with scientific precision. Water is of great consequence ; the soil should be supplied so as to keep the soil gently moist throughout. Shading is sometimes very necessary. Manure-water is sometimes useful ; it can be made by pouring a gallon of boiling water upon a small shovel of pigeons' or sheeps' dung, with an ounce or two of lime ; and, after beating the whole to mix the materials thoroughly, diluting the fluid with four gallons of rain, or soft pond-water. When used, the liquid is to be stirred up, and applied to the extent of a quart or more to each pot, once a week ; then, washing the manure into the body of the soil by pouring clear water upon the surface till some of it run through the holes of the pots.

The question of the utility of manure-water is still somewhat ambiguous. I therefore recommend a weakened application, preferring to leave the results to the observation of the cultivator, rather than to lay down prescriptive rules ; for it is certain that, however a person may endeavour to conform to directions for preparing manures or compost soils, he can

never be certain that he has obtained one which is similar to that employed by any writer, in consequence of the dissimilarity which exists in the loams and sands of different localities. If the cucumber-plants prosper, they may each produce a dozen fruits between April and Midsummer, when those of the frame will come into bearing.

### THE PERSIAN MELON.

The melon, *cucumis melo*, is a species of the genus *cucumis*, one of the many families which are found in the natural order *cucurbitaceæ*:—that is to say, it belongs to a tribe of plants whose natural characters resemble those of the gourd *cucurbita*, its type. *Cucumis*, cucumber, is derived from the Greek *kekumai*, a term which implies *tumidity*,—very appropriate to the melon. *Melo*, the specific name, comes from *melo*, Latin, derived from *Μηλον*, whence melon, and *malum*, an apple. The word is applicable, in a degree, to the figure, but more so to the odour of the fruit; which, in many cases, is far from dissimilar to that of a fragrant apple.

*Cucumis* is found in Class **xxi**. *Monœcia*, Order **viii**. *Monadelphica*, of Linnæus. Its generic character is the following:—

*Male flower.* Calyx, five-toothed; Corolla, bell-shaped, of one petal, in five deep divisions; Stamina, three, united at the base.

*The female* resembles the male generally; but in lieu of stamens it has a three-cleft pistil, or central column, with a three-parted, rough, somewhat reflexed stigma, and a swollen inferior germen, or ovary, with gourd-like seeds, which become the fruit.

Referring to LINDLEY'S *Guide to the Orchard and Kitchen Garden*, p. 235—9, for the list of the then known varieties of Persian melons, I restrict my remarks to the two choice varieties sent to me direct by the late Mr. Knight, accompanied and followed by a series of original and luminous remarks. These are the two Housainees, or Hoosainees.

1st. The *striped* Housainec is a fruit of great beauty and excellence; its skin is firm, but thin; the cellular substance immediately under it, and to the depth of nearly a quarter of an inch, is of a bright pea-green, gradually becoming paler till it meets and blends with the inner and main portion of the flesh, which is of a pinkish buff, or salmon colour. The green portion is not quite so tender and juicy as the pink, but the whole may be eaten, with the exception of a thin exterior integument. Here there is no thick and tough rind; all is juicy and tender. The odour is fragrant, and never fetid as that of the common melon, and the flavour delicious. The only fault of the fruit is its tardiness; it frequently requires from fifty to seventy days from its setting to attain complete maturity. During its early growth its skin is of a rich green, interspersed

with stripes and blotches of a darker hue. As it advances to maturity the fruit becomes netted. A degree of distinctive odour is perceptible, but this must not be assumed as the criterion of ripeness. "Little globules," says Mr. Knight, "apparently of water, but really composed of the juice of the fruit, appear at the juncture of the fruit and its stalk. If such bubbles appear, and are sweet to the taste, the fruit should be instantly cut." These remarks apply to the other variety now to be noticed.

2nd. *The white-fleshed Housainee* is now proved to be a distinct variety. The fruit is not only smaller than the green striped, in the proportion of about four pounds to seven pounds, but its flesh is of a pure cream-colour, approaching to white; it is also more globular in figure. Like the former, its ground-colour is green, varied with darker stripes; but its ultimate reticulations are much less, and consequently it never assumes the gray hue of the *striped Housainee*.

It ripens in a shorter period, but is liable to crack previously, which forms somewhat of an objection; yet its flavour is so pure and fine, and its prolificity is so great, that it ought to be found in every good garden.

It was Mr. Knight's grand object to maintain each variety true to its character; therefore, the two should be grown in separate departments, and wherein, at all events, no common melon must ever be suffered to intrude.

The leaves of both Housainees are very large and handsome; but the blossoms are small, of a pale yellow, and comparatively insignificant. The plant of each variety, in its habit of growth, is one of the finest and most interesting of objects. The stem, if led perpendicularly to the height of three feet, will comprise about ten clear joints. From each joint, at its angle, a noble leaf, nearly a foot in diameter, is produced; it is supported by a footstalk ten inches in length, that takes a most graceful bend, in figure resembling the branch of a chandelier. It is heart-shaped, obtuse at the point, very broad at the base. From each axil a lateral might be produced; but in upright training these must be obliterated till the plant attain the trellis.

To acquire a philosophical idea of a plant and its culture, the gardener should make himself acquainted with its habits in its native clime. Speaking of the Persian tribe generally, Lindley says, "They are found to require a very high temperature, a dry atmosphere, and an extremely humid soil; while they are at the same time impatient of an undue supply of moisture, which causes spottings and decay long before the fruit is ripe. It is not easy, therefore, to maintain that necessary balance of heat and moisture which in Persia arises out of the very nature of the ~~clime~~ and mode of cultivation. In that country, we are told, that the melon is grown in open fields, intersected in every direction by small

*streams*, between which lie elevated beds, richly manured with pigeons' dung."

The inference to be drawn from these facts is,—that a soil well drained should form the bed of the plant, and that wherein its main roots should be fixed; but that the rootlets ought to have access to a body of water, situated however, *below* the base of the real bed. An accidental occurrence enabled me to ascertain the truth of this inference. I communicated the fact to the Horticultural Society, and I shall now again allude to it.

A plant of the green Housainee was cultivated in a small stove. It grew in a pot, plunged in a bed of leaves, close to the end wall of the tan-pit; against which, on the outside of the wall, there was a small tank of water. One of the main roots passed through the bottom of the pot, and ran against the inner surface of the wall. Attracted by the water, it sent forth a process, through the mortar joint of the wall, into the tank. When there, though the aperture was too small to be discerned, the root quickly developed a complete brush of beautiful white fibres, which gradually extended themselves throughout the water of the tank. I sent a portion of these roots, preserved in spirit of wine, to the Horticultural Society, and retained another; it is now in complete preservation.

*General Habits of the Melon Plant.*—It is perfectly consistent with fact that the plant is by nature a climber; yet we have, till within a very recent period, treated it as a creeper, and hence have subjected it to many casualties. It has become the prey of a variety of insects, and the fruit has on many occasions been devoured by wood-lice or snails. Setting aside accident from these vermin, the foliage has rarely been duly exposed to the sun, and the fruit has ripened and assumed its natural tint on the upper side only, while the lower, if resting on the damp earth, has either decayed or remained pale and immature.

Lately, gardeners have adopted the more scientific method of leading the stems of cucumber and melon plants in an upright direction, to the length of a foot or more; training the vine and foliage horizontally, or in a slope, upon a trellis eight or ten inches below the glass.

Mr. Patrick's pits, described in the preceding article, are admirably adapted to the growth of the Persian melon. Keeping every fact in view, we may consider the following rules as established axioms:—

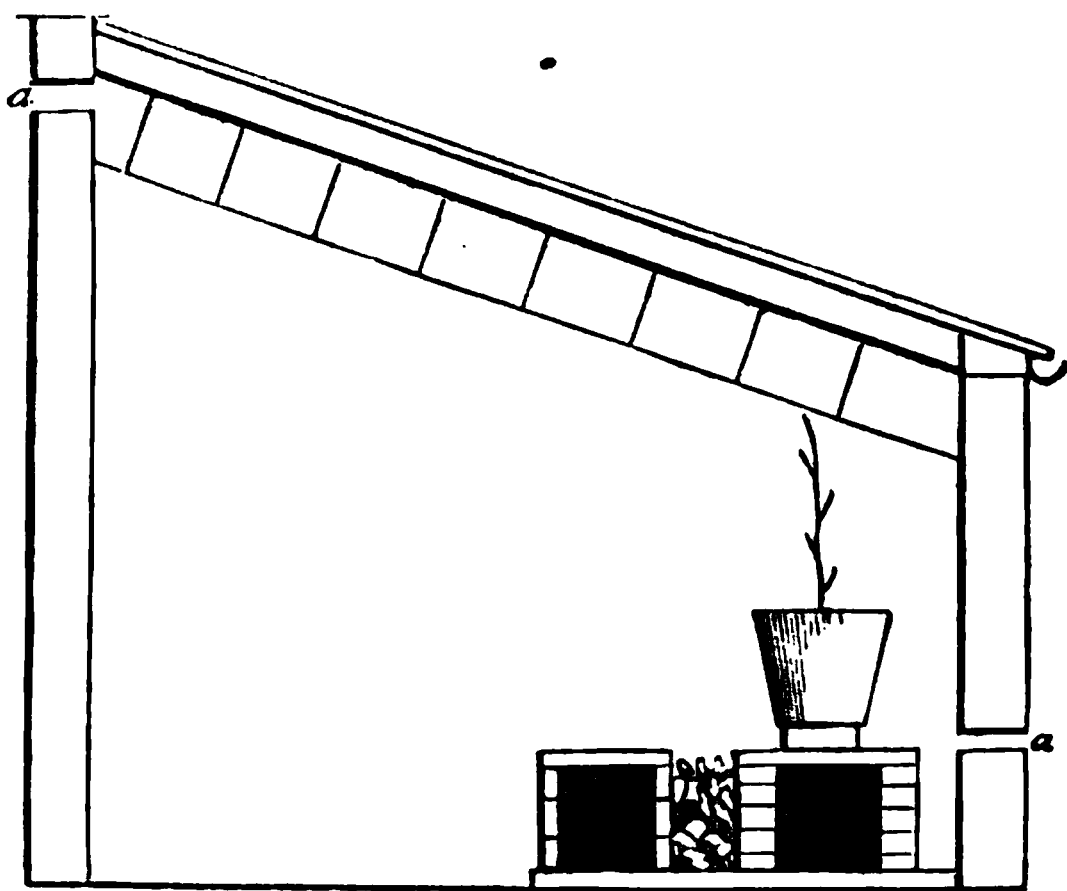
*First.* The plants are tender and succulent, the natives of a hot climate, in which, however, a great degree of cold is occasionally experienced during the nights. They, therefore, with us, require the protection of a well-constructed erection, wherein high temperature ( $70^{\circ}$  to  $90^{\circ}$ , with a free access of air), may be excited during sunshine. A reduction of night temperature to the extent of  $10^{\circ}$  or  $13^{\circ}$ , can never be productive of injury.

*Second.* They are climbers, therefore they ought to be treated as such, —the main stem being led perpendicularly to the extent of ten joints, before the fruit-bearing laterals be permitted to range horizontally.

*Third.* They delight in water, but affect a dry soil and atmosphere; hence the mass of roots should be developed in an elevated bed of alluvial turfy loam, fresh from the pasture; but the finer and remote rootlets may be permitted to extend themselves into water on every side. An experiment founded upon my discovery was instituted in the Society's garden, and lately announced in the *Horticultural Transactions*.

Having thus premised, I now arrive at the description of Mr. Knight's melon-house, which is, perhaps, one of the most efficient pieces of machinery for forcing this fruit that has ever been erected.

It was given in a paper written by the president, and read at a meeting of the Fellows of the Horticultural Society, May 1, 1831. The dimensions of the house are stated to be :—Height of the back wall, nine feet; of the



front wall, six feet nearly; length, thirty feet; breadth, nine feet, internal measure. The fire-place is at the east end; the flue is double; the first course built of bricks, laid flat, four inches within the front wall; the second course is parallel with the former, built of bricks on edge, and has a space of eight inches between the two courses, which is filled with fragments of burnt bricks. These absorb much water, and yield it gradually in the form of vapour.

Air is admitted through apertures (marked *a a*, in the plan), in the front wall, which are four inches wide, and nearly three in height (*i. e.* a half-brick space is left in the wall), situated level with the top of the flues, eighteen inches apart. It escapes through similar apertures near the top of the back wall. These are opened or closed, as circumstances require.

Thirty-two pots, sixteen inches deep, seventeen inches wide at the rim, and fourteen at the bottom, are arranged along the front flue; but each stands upon a brick to raise it above the burning heat of the flue.

One plant is grown in each pot, and this is never permitted to bear more than one fruit. The stem advances till it reaches a trellis, fourteen inches below the surface of the glass, and to this the shoots are trained.

This extract contains the substance of the paper, and the annexed plan exhibits the profile of the erection. The vinery before described would answer every purpose, but the angle being more sharp, it might not be so well adapted to the altitude of the sun during the three spring months.

*The soil* recommended to me by Mr. Knight, is the chopped green turf of an alluvial meadow, incorporated with a portion, (one-sixth to one-fifth,) of recent horse-droppings, pressed firmly into the pots. The seed should be sown in small pots, one in each, about the last week of March. Each pot is first to be netted with hay, or dry moss, then filled with light loam, mixed with a little leaf-mould or heath soil. The seed is to be pressed down half an inch deep, and covered compactly with the soil, which is to be kept free, but by no means wet. The pots ought to be plunged in the earth over a hot-bed of dung, as in that genial and moist atmosphere the seeds, if good, will vegetate speedily; and as each plant advances, its roots will mat into the hay, and the ball will come out entire, without disturbing the fibrous processes; thus, no time will be lost. It may be removed from pot to pot as the roots fill their allotted space; but this is not required,—for, when it shall have four perfect leaves, it may go at once into its fruiting-pot, and be subjected to the treatment suggested by Mr. Knight, in a letter dated June, 1832. Thus, the Housainees are to be stopped at the tenth joint, (the Ispahan sweet melon at the twelfth,) by pinching off the point when very small. Two of the strongest laterals are subsequently to be selected and trained on the trellis; and when two melons are distinctly perceptible, one of the shoots is to be stopped at two joints beyond a showing fruit, but the other is to be allowed to proceed unchecked.

The female blossoms are next impregnated by taking a male flower, manifestly productive of free farina. After the corolla of the latter is pulled off, or folded back, it is to be held by the stalk inverted over the female, the stamens made to touch the stigma; and in that position pressed firmly, but not with violence, upon it.

“If,” he added, “the pollen be properly introduced, one of the fruits never fails to set; and when both set, I generally prefer the fruit which grows upon the shoot that has not been stopped.”

The number of fruit which a Housainee plant can produce, must be regulated by the extent of foliage presented to the light. “One fruit of

four pounds in weight, may be allowed to every four square-feet of glass."

*Water.*—The plants grown in pots, if placed on the flue, must be freely supplied with water. Mr. Knight employed liquid manure, prepared by steeping pigeons'-dung in water; this he considers the best food of the plant; but he gave much pure water, even daily, in hot weather, and always in sufficient quantity to reach the bottom of the pots; but when the fruit was fully grown, so much water only was given as would keep the plant alive."

They who prefer the method of plunging the pots in a bed of leaves, or of planting without pots in a deep bed of earth, lying upon leaves or turf, either in the stove or in a brick glazed pit, need not give so large a quantity of water; and may be assured of success, provided the soil be a *fresh* mellow loam, and not that of a manured garden, which is always infested with insects.

Well-reduced leaf-mould alone will produce and support excellent melons: this I have seen proved. Mr. Knight also assured me that *all* melons will certainly succeed in pots, and that the *green-striped Housainee* will do perfectly well in any common hot-bed; but, as the skin of the fruit is very thin, it will be prudent to raise it above the mould upon a little cradle. The point also of the fruit should be a little elevated, otherwise it will be rather liable to crack.

*In growing melon-plants of any kind* in a bed of earth, the preparation of the soil is of great consequence. Mr. Patrick's brick pit, prepared as described for the cucumber, comprises every convenience; the first of which is, a deep bed of *maiden* turfy loam, unctuous, but not of a hard-binding texture. There will be no dung in the proximity of the roots; and if the remote fibres court it, they can wander through the pigeon-holes to the old manure at the end of each pit. As under each light a melon-plant or two will be planted, a hill of the lightest of the soil should be prepared; and to ensure the safe removal of the plants without check, they should be growing in pots of the size thirty-two, the bottoms of which had been previously beaten out, their place supplied with an inverted turf. Once established in such a vehicle, a transfer can be made without risk, by plunging the pots nearly to their rims in the hills. The roots will speedily pass into that of the hill; and when they appear at the surface, a fresh addition of fine mellow soil, reserved at the inner sides of the pit, must be made, just to cover, but not to bury, the fibres deeply. Water may be freely given in warm weather, but never within the plunged pots. The stems should be dry, but the remotest fibres moist.

*Practise little stopping.* Bring forward two series of laterals; the first, by pinching off the extreme point, about the third joint; a second,

when the shoots so produced have made three or four joints more. Fruitful laterals will appear; those may be thinned entirely out which crowd the best fruiters; but the latter should proceed on to attain the boundaries of the pit or frame. As each plant will have several fruits, it will be wise to try the comparative effects of stopping close to a melon, here and there, and of permitting other fruit-bearing shoots to advance unchecked. Experience will thus be established.

*Propagation by Cuttings.*—Whenever the quality of any fruit is highly approved, cuttings of the strong fruiting shoots, taken at the third joint from the extremity, placed in a bottle of water, in heat, will strike root; so will they also in mould contained in small pots, plunged in a warm bed of leaves or earth. Those from the water should be potted when the roots are half an inch long. These cuttings, treated as the seedlings, till they are in the thirty-two pots, will form bearing plants immediately, particularly if, when placed on the hills and in vigorous health, the point of the shoot be pinched off once. Loudon, on viewing the melons at Petworth House, observed, “In five or six days *after* planting, if the cuttings have been taken with fruit-blossoms just beginning to expand, *upon rooted cuttings*, the fruit will be as large as hens’ eggs. In three weeks the greater part will be full grown; in five weeks the plants will have furnished three or four ripe fruit, and will be ready to be pulled up and be replaced by others.”

The total product is represented as astonishing.

Be it remembered that these cuttings are raised in a frame set apart expressly for rooting them; and “in it, a stock of rooted plants, but never of more than three or four days’ growth, are kept all the summer.”—(*Gard. Mag.* vol. v. pp. 578—9.)

The experiment is worthy of a trial; the practice is one of routine, in which a first attempt may entirely fail. It *reads* well, but I never observed the practice in any garden.

## THE PINE-APPLE.

*ANANASSA SATIVA.* Natural order, *Bromeliacæ*. Class vi. Order i. *Hexandria Monogynia* of Linnæus. Calyx, in three divisions; Corolla, of three petals; Seeds buried in a fleshy receptacle. This genus has been recently separated from *Bromelia*, the fruit of which is worthless.

The fructification of the pine-apple is thus described:—

“The fruit is a mass of flowers, the calyces and bractes of which are fleshy, and grow firmly together into a single head. It is the points of these parts that together form what gardeners call the pips,—that is to say, the rhomboidal spaces into which the surface is divided. When

wild, pine-apples bear seeds like other plants, but in a state of cultivation, generally owing to the succulence of all the parts, no seeds are produced; and consequently the plants can only be multiplied by suckers, or by their branches, which gardeners call the gills and crowns."

*Varieties* are numerous; fifty are described in the catalogue of the London Horticultural Society: but few of these are required; and in all cases one variety only should be grown in one department, because each requires some peculiarity of treatment.

There are two which are adapted to winter fruiting:—I. The old black *Jamaica*, thus described in the catalogue alluded to, No. 11:—"Leaves rather long and narrow, slightly spreading, and somewhat keel-shaped, of a dull green, tinged with a dark-brown colour, and rather mealy; spines short, regular, and thinly set; flowers purple; fruit oval; pips roundish, rather large, compressed in the middle. Fruit of a very dark olive-green before it is ripe, it then changes to a palish yellow, slightly stringy; flesh very rich and juicy, and most highly flavoured. Weight from two to five pounds. According to Speechley, it produces a fruit, even during autumn and winter, more swelled and perfect than any other fruit."

Gardeners object to this plant, on the following grounds:—It does not fruit so readily,—say they,—as the Queen; it is shy of producing suckers, and is tender. The truth is that, in bottom heat, the roots being rather sensitive, and few in number, are apt to be injured, or, as it were, dissolved, if exposed to considerable, and especially sudden increments of heat.

Mr. Knight cultivated this pine with the greatest success, without plunging into any fermenting mass whatever; he obtained one perfect sucker from a plant,—perhaps two; and occasionally grew his succession plants on the old stocks.

II. The St. Vincent, or green olive pine. This was another favourite of the late venerable president, and was grown by him in his own scientific manner. It is found at No. 21 of the Catalogue.

"Flowers purple, middle-sized. Fruit bluntly pyramidal, slightly mealy, and of a dull olive colour. When ripe, of a dingy yellow, from two to four pounds, highly flavoured, and swells readily during the winter months. Crown, middle-sized; leaves rather numerous, and slightly spreading."

III. The Queen, Old Queen, and particularly that fine sub-variety the broad-leaved Queen of the Catalogue, No. 45, are the only general favourites: the *Ananas Ordinaire* of the French. Leaves very short, broad, and stiff, somewhat spreading, and keel-shaped, of a bluish-green, and thickly covered with meal. Spines strong, rather far apart, green and mealy; when ripe, of a rich, deep yellow. Flesh, pale yellow, very

slightly fibrous and melting; remarkably juicy and sweet, with a little pleasant acid. Crown, middle-sized; leaves numerous, and rather spreading; a valuable pine weighing from three to five pounds.

The Queen pine is a true summer fruit. It is a free and hardy rooter; and, being, when grown by a skilful and practised gardener, subject to few accidents, and very productive of suckers, it is preferred beyond every other variety.

The following method of cultivating the pine is extracted from an article in the *Gardeners' Magazine*, vol. i. p. 426. It was written by, perhaps, the best pine-grower in Berkshire\*, is clear and concise, and, by introducing some practical remarks, I hope to render it still more so: modifications are easily adopted.

“The following directions are for the management of pine-plants that are intended to show their fruit eighteen months after removal from the parent plant. In the end of August, or beginning of September, prepare a pit for the crowns or suckers. A bed, twenty-four feet by six feet, will hold four hundred plants. Stick in the crowns and suckers as thick as they will stand, and about one inch and a-half deep. Keep to 70°, and shade during hot sunshine. Through the winter apply dung linings to keep the internal air between 50° and 60°, and protect the glass with mats during the night. If the bed should get very dry, give a gentle watering over the surface. No other care or attention will be necessary till March; the roots will then have run nearly over the surface of the bed, and consequently the plants will require potting.”

This first paragraph premises some acquaintance with pine-culture, and that, it is intended to commence on a bold scale. I, on the other hand, suppose a case in which a *first attempt* is made, with only a few dozens of crowns and suckers. The bed alluded to is one of tanners' bark, the surface of which is so decayed by fermentation, as to approach to the condition of rotten wood; a little bottom-heat, perhaps of 70°, existing below the surface.

But pine-suckers and crowns never strike root better than in a common dung hot-bed; and if few only be obtained, it will be better to prepare a one-light frame, over a deep bed composed of leaves and fresh stable-dung,—two parts of the former and three parts of the latter; both thoroughly and minutely mixed with the fork, and suffered to ferment in a heap for one or two weeks. The bed should then be made perfectly even, flat, and solid, the frame and lights put on, and left till the heat rise. A thermometer will show the temperature of the atmosphere therein; and when this indicates 70°—75° without sun, the plants may

\* From a paper read at a meeting of the Horticultural Society, April 19, 1825, written by Mr. W. Greenshields, gardener at Englefield House, Berkshire.

be safely introduced. These preparations ought to be completed by the middle of September at the latest; because the plants strike very indifferently at a later period, and are apt to damp off. In the mean time, the crowns and suckers (the larger they are the greater the chances of success) should be divested of some of their lower leaves by scaling them off with an oblique twist, so as to leave a clear space of an inch and a-half or two inches of straight stem to go into the soil. The bottom or heel of each crown or sucker should be pared even with a knife, and then deposited in a dry room for a week or more.

In planting the suckers, it will be the safest method to begin with the pots called sixties, large or small, according to the size of the plants; using a soil composed of black, sandy, heath-mould, and light loam, thoroughly mixed; having previously put half an inch or more of chips of broken pots, or small cinders, into the bottom of each pot. If the bottom-heat of the bed, at the depth of the pots, do not exceed  $95^{\circ}$ , and the atmosphere of the frame  $65^{\circ}$ , the pots and plants may be plunged in the dung to the rims. If it range from  $98^{\circ}$  to  $105^{\circ}$ , the surface should be covered with a bed of saw-dust or leaf-mould, or sand, six inches deep, into which the pots are to be plunged; or if the crowns and suckers are to be simply stuck into the bed, leaf-mould alone should be the material employed.

Two conditions are to be observed: the *first*, that,—in planting,—the earth of the pot or bed must be pressed firmly around the base of the plant.

*Second.* If the hot-bed retain the plants throughout the winter, fresh linings must be heaped to the top of the frame, and the glass be covered during frost with boards, and a quantity of dry straw or hay. Mats soon become wet, and conduct away the heat. But as the plants in pots, if they succeed, will be well rooted by the middle of October, much trouble will be saved by removing the stock to a low stove, furnished with a deep bed of leaves; for there, the flue will secure the plants from damp, and keep up that gentle degree of warmth which will be consistent with safety, without exciting unnatural *growth*.

“Plant in pots of about six inches in diameter, for the largest plants, and for the smaller in proportion. Leave on all the roots, and strip off three or four of the bottom leaves. Use deep potting, which is of great advantage to pine plants in all stages of their growth. When the potting is finished, and the plants are set in the pits, shut the lights down close, letting them remain so from four to eight days, shading in hot sunshine. Keep the air to  $70^{\circ}$  for the first three weeks; in that time the plants will be well rooted, and will then require free admission of air, and watering about twice a week, as well as frequent sprinklings with the engine in hot dry weather. The top heat must then be maintained with

dung-linings to  $65^{\circ}$ , and the lights must be covered with mats at night till the summer heat makes it unnecessary,—this will be in the month of June. At that time the plants will require potting in pots two sizes larger than the last. There will be no fresh tan wanted at this season for the bed; turning it over one fork deep to level the surface is all that will be necessary. Pot the plants, with balls entire, using the mould in this and every other potting in as rough a state as possible.

“About the middle of August or September the plants will require potting in their fruiting pots, from twelve to fourteen inches in diameter. Put the plants with balls entire, and deep in the pots, stripping off a few of the bottom leaves to let them push out fresh roots. In setting the pots, give them plenty of room, for they will make considerable progress after this potting. When the setting is finished give a little water to settle the mould; the plants will not require any more for ten days or a fortnight after. Keep the house rather warm, to make them root freely, and then water whenever they appear dry, which is the best criterion to go by in the autumn and winter months. Give plenty of air whenever the weather permits, and sprinkle with water when the bark-bed and house become dry.

“Begin fire heat when the internal heat of the house in the morning falls below  $60^{\circ}$ , keeping between that and  $65^{\circ}$  to the middle of January, when a rise of  $5^{\circ}$  will be necessary. In April, fork the bed over two forks deep, adding a little fresh tan quite at the bottom of the pit, and then level the surface. Before the plants are replaced, three or four of their bottom leaves should be stripped off, and a little of the old mould taken from the surface of the pots, and replaced with fresh mould, raised quite to the tops of the pots. When the plants are returned into the bed, plunge the pots to half their depth only, (this should be observed at all other settings, as there is nothing so injurious to a pine-plant as too much bottom heat,) giving plenty of room and a gentle watering. Keep the house rather warm for the first week, till the heat of the bed returns. Give air whenever the weather will permit, watering about twice a week in hot, dry weather; and sprinkle with the engine frequently, when the house is shut up in the evening. There will be no further attention necessary till the fruit is swelled to its full size, and begins to ripen; then all waterings should be discontinued, and a free circulation of air admitted to bring the fruit to its due flavour.

The foregoing rules, the writer says, are applicable to pines which are to produce a general summer crop. “When ripe fruit is required earlier or later, the different pottings, &c., must be varied accordingly, and be done earlier or later, as the fruit may be required to come in for use at an earlier or later season.

“*The compost mould* to be used at all the pottings should be strong

*surface loam, and half-rolled hog dung, of each, equal quantities, kept as rough as possible.* The mixture should never be used when more than twelve months old. It may be here observed that no pine should be checked in its progress; for the consequence of checking is always a premature and weak production of fruit."

The first remark of moment applies to the soil or *compost mould* named above, "*a strong surface loam,*" and the dung of swine. The surface, or grassy turf of a sheep-walk or pasture is, and must be good, because of the decomposable, vegetable substances which it contains; but what is to be understood by the term *strong loam*? Most readers would conclude that a stiffish clayey earth is meant; but he that should attempt to grow the pine-plant in such a medium, would experience much perplexity. Again, there is a strong garden loam, which binds during hot weather into clods, as hard as a brick; which nevertheless breaks down to a powder when wetted by a shower. If half a pound of this soil be intimately mixed up with a quart of water, and suffered to rest for only a few seconds of time, it will be perceived that three-fourths of the whole have been deposited in the form of a coarse, gritty sand. Such a loam I have ever found to be inimical to the roots of a pine. By the term, "*strong loam,*" in reference to a healthy medium for pine-plants, we therefore must understand a soft, velvety earth, abounding with fine silex, or pure earth of flints, blended with ochre, which will remain almost entirely suspended in water, and can be poured off with it, leaving scarcely one-sixteenth part of gravelly fragments. The best pine loam that I have ever seen contains nine-tenths of a fine silex, that cannot be dissolved in any of the mineral acids, about one-twentieth part of coarser sand, a very small portion of chalk, scarcely discoverable by muriatic acid, and about six or seven per cent. of ochreous matters; the colour is a pale hazel; the texture lumpy and firm till wetted, and then breaking down into an open mellow soil, as soft or unctuous as fullers' earth. This mellow loam is rich, (strong,) and peculiarly propitious to the pine.

The earthy medium is the great desideratum, while it forms the chief difficulty of the pine-grower; who, if he possess a suitable loam, may blend it with leaf-mould, heath-soil, the dung of sheep, swine, or of the horse, all more or less fermented, and yet succeed to his heart's wishes. Without it he may experimentize, and tax his abilities to the utmost; but vexation and disappointment will meet him at every stage.

Another extremely good soil for the pine is the earth from decayed couch-grass roots, perfectly reduced; it is unctuous, soft, and very nutritive.

Mr. Greenshield's process ranks among the best; but it may be simplified by adopting the pits used by Mr. Patrick, described in the article upon the cucumber. I inspected his ranges in 1838, and saw pine plants

in every stage, of a quality which altogether surpassed those of ordinary culture.

It may be asserted as a fact, founded upon experience, that, with the exception of the method of culture without bottom-heat or plunging, adopted by the late Mr. Knight, success depends upon the rapidity with which a pine-plant is carried through every stage of its course; and therefore that, from the sucker to the developement of the fruit, fifteen months ought to complete the period of its growth.

Now, in Mr. Patrick's pigeon-holed flued pits, four feet six inches wide in the clear internal measure, surrounded by hot-dung linings, a plant never can be checked in its progress, provided the linings be duly renewed, and in winter built up to the full height of the walls. The plants I inspected in May, 1838, had passed through the severity of January, ( $2^{\circ}$  —, or  $34^{\circ}$  of frost,) without a check, and never in an atmosphere reduced below  $65^{\circ}$  to  $70^{\circ}$ . But to guard against any casualty, a course of hot-water pipes might run along the front wall, level with the top of the flue of all the pine divisions.

No earth was introduced into those pits; but in lieu of it, about two feet of long stable dung. Upon this bed the pots were set, and pressed down just so low as to prevent their falling over.

*Bottom-heat* was not affected by Mr. Patrick; a genial temperature, equable throughout, was secured by the steady heat of the linings, and retained during the cold weather, by a deep covering of litter at nights, and throughout gloomy days.

*No water* need be given during November, December, and January; but a little, with the chill off, in February; and subsequently, an increased quantity, as solar light increases and prevails, will be required.

From May to the middle of August, high, *moist* temperature, and a soil, moderately so, but never wet, are essentials.

In the fruiting stage, when the fruit begins to turn off, water must be by degrees withheld, and much more air admitted.

The *soil* employed by Mr. Patrick was a strong, nut-brown loam, taken rather below the turf; *two* parts of this, to *one* part of the half-reduced dung of his linings; these were left to incorporate in a heap, which was mixed and turned twice or three times.

By combining the above machinery with the practice detailed by Mr. Greenshields and in the annexed remarks, a little experience will qualify any attentive gardener to become a good pine-grower: a qualification which, if found united with that of a skilful cultivator of the vine, will place him in the highest grade of his profession.

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# THE ENGLISH BOTANIST'S COMPANION.

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THIS catalogue is now differently placed, and its materials are collected together, instead of being dispersed through the body of the work: hence, some modification has been required. In conformity with the fashion of the day, it might have been thought necessary to refer to the *natural* or Jussieuean *system* of Botany. That system cannot be too much lauded, as comprising the entire *Science of Physiological Botany*,—but it is yet incomplete, and involves perplexities and difficulties, which may embarrass thousands. Again, the catalogue was originally derived from the late Sir J. E. Smith's last edition of the *English Flora*, and as it remains essentially the same, I have preferred to adhere to the Linnæan classification, adding the following concise tables, in order to serve as a reference to the titles of the Classes and Orders. Of this arrangement, it has been justly said, (and how many can vouch to the fact,) that “Linnæus has given the most beautiful *artificial* system that has ever been bestowed by genius on mankind!” Can we then abandon it?

The subjects contained in the 24th Class, *Cryptogamia*, are omitted. That class contains subjects of extreme beauty, but as Sir J. E. Smith included in his *English Flora* only the order *Filices*, or ferns; and as that work has been exclusively consulted, it is thought advisable to restrict the catalogue to the twenty-three classes of Linnæus, which comprise all the British plants whose fructiferous organs are open and revealed to light.

The titles are chiefly of Greek derivation; this is shown in the table. The thirteen classes, (from 1 to 13, inclusive,) are governed by the *number* of the stamens. The remaining ten, by the position, or distribution of the stamens. Sometimes, also, (in classes 20 to 24,) as refers to their situation, relative to the pistil.

STAMENS.	CLASSES.	ORDERS.
One.	1. MONANDRIA, from <i>monos</i> , one, and <i>aner</i> , man.	Two: 1. Monogynia, (from <i>monos</i> , one, and <i>gyne</i> , a woman, or pistil); 2. Digynia, ( <i>dis</i> , two.)
Two.	2. DIANDRIA.	Three: 1. Monogynia; 2. Digynia; 3. Trigynia, (from <i>tris</i> , three.)
Three.	3. TRIANDRIA.	Three: 1. Monogynia; 2. Digynia; 3. Trigynia.
Four.	4. TETRANDRIA, (from <i>tetra</i> , four.)	Three: 1. Monogynia; 2. Digynia; 3. Tetragynia.
Five.	5. PENTANDRIA, (from <i>pente</i> , five.)	Six: 1. Monogynia; 2. Digynia; 3. Trigynia; 4. Tetragynia; 5. Pentagynia; 6. Polygynia, (from <i>polus</i> or <i>polys</i> , many.)

STAMENS.	CLASSES.	ORDERS.
Six.	6. HEXANDRIA, (from <i>hex</i> , six.)	Four: 1. Monogynia; 2. Digynia; 3. Trigynia; 4. Polygynia.
Seven.	7. HEPTANDRIA, (from <i>epta</i> , adding <i>h</i> , seven.)	Four: 1. Monogynia; 2. Digynia; 3. Tetragynia; 4. Heptagynia.
Eight.	8. OCTANDRIA, (from <i>octo</i> eight.)	Four: 1. Monogynia; 2. Digynia; 3. Trigynia; 4. Tetragynia.
Nine.	9. ENNEANDRIA, (from <i>ennea</i> , nine.)	Three: 1. Monogynia; 2. Digynia; 3. Hexagynia.
Ten.	10. DECANDRIA, (from <i>deka</i> , ten.)	Five: 1. Monogynia; 3. Digynia; 3. Trigynia; 4. Pentagynia; 5. Decagynia.
Twelve.	11. DODECANDRIA, (from <i>dodeka</i> , twelve.)	Six: 1. Monogynia; 2. Digynia; 3. Trigynia; 4. Tetragynia; 5. Pentagynia; 6. Dodecagynia.
Several, about twenty.	12. ICOSANDRIA, from <i>eikos</i> , twenty; they are generally affixed to the calyx.	Three: 1. Monogynia; 2. Di-pentagynia; i. e., from two to five pistils; 3. Polygynia.
Many.	13. POLYANDRIA, (from <i>polus</i> , many, not attached to the Calyx.)	Five: 1. Monogynia; 2. Digynia; 3. Trigynia; 4. Pentagynia; 5. Polygynia.
Two long, two short.	14. DIDYNAMIA, (from <i>dis</i> , two, of two; <i>dynamis</i> , power, or greater size.)	Two: 1. <i>Gymnospermia</i> , (from <i>gymnos</i> , open, and <i>sperma</i> , seed): 2. <i>Angiospermia</i> , (from <i>aggos-eos</i> ,) seed-vessel closed, or bound.
Four long, two short.	15. TETRADYNAMIA.	Two: 1. <i>Siliculosa</i> , (from <i>silicula</i> , a pouch, or silicle); 2. <i>Siliquosa</i> , (from <i>siliqua</i> , a silique.)
United at the base, into one.	16. MONADELPHIA, (from <i>monos</i> , one, and <i>adelphos</i> , brother.	Seven: 1. Triandria; 2. Pentandria; 3. Heptandria; 4. Octandria; 5. Decandria; 6. Dodecandria; 7. Polyandria.
In two portions.	17. DIADELPHIA. Two sets.	Four: 1. Pentandria; 2. Hexandria; 3. Octandria; 4. Decandria.
In several sets.	18. POLYADELPHIA.	Four: 1. Decandria; 2. Dodecandria; 3. Icosandria; 4. Polyandria.
Anthers joined.	19. SYNGENESIA, (from <i>syn</i> , together, and <i>genesis</i> , an origin or parent.)	Three, in English genera; 1. <i>Polygamia equalis</i> ; 2. — <i>superflua</i> ; 3. — <i>frustranea</i> .
Stamen joined to the pistil.	20. GYNANDRIA, (from <i>gyno</i> , and <i>aner</i> .)	Three: 1. Monandria; 2. Decandria; 3. Hexandria.
Stamens and pistils separate on the same plant.	21. MONÆCIA, (from <i>monos</i> , and <i>oikos</i> , a house.)	Eight: 1. Monandria; 2. Diandria; 3. Triandria; 4. Tetrandria; 5. Pentandria; 6. Hexandria; 7. Polyandria; 8. Monadelphia.
Separate, on two plants.	22. DICECIA, (from <i>dis</i> and <i>oikos</i> .)	Fourteen: 1. Monandria; 2. Diandria; 3. Triandria; 4. Tetrandria; 5. Pentandria; 6. Hexandria; 7. Octandria; 8. Enneandria; 9. Decandria; 10. Dodecandria; 11. Isocandria; 12. Polyandria; 13. Monadelphia; 14. Gynandria.
On the same, and separate plants.	23. POLYGAMIA, (from <i>polys</i> , many, and <i>gamos</i> , marriage.)	Two: 1. <i>Monœcia</i> , male, female, and hermaphrodites, on the same plant; 2. <i>Dicecia</i> , on two plants.

## JANUARY.

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Primrose, common	<i>Primula vulgaris</i>	5.	1.
Chickweed, common	<i>Stellaria media</i>	10.	3.
Christmas rose, } common	<i>Helleborus foetidus</i>	13.	5.
Bear's foot, }			
Dead Nettle, } red	<i>Lamium purpureum</i>	14.	1.
Archangel, }			
Do. do. white	— album	—	—
Furze or Gos, common	<i>Ulex Europæus</i>	17.	4.
Dandelion, common	<i>Leontodon taraxacum</i>	19.	2.
Daisy, common	<i>Bellis perennis</i>	—	—
Groundsel, common	<i>Senecio vulgaris</i>	—	—

## FEBRUARY.

Speedwell, proc. field	<i>Veronica agrestis</i>	2.	1.
Primrose, common	<i>Primula vulgaris</i>	5.	1.
Snow-drop, common	<i>Galanthus nivalis</i>	6.	1.
Mezereon, common	<i>Daphne mezereum</i>	1.	1.
Spurge laurel, common	— laureola	—	—
Cinquefoil, strawberry-leaved	<i>Potentilla fragariastrum</i>	12.	3.
Pilewort	<i>Ranunculus ficaria</i>	13.	5.
Dead-nettle, red	<i>Lamium purpureum</i>	14.	1.
— henbit	— amplexicaule	—	—
Furze or Gos, common	<i>Ulex Europæus</i>	17.	4.
Groundsel, common	<i>Senecio vulgaris</i>	19.	2.
Dandelion, common	<i>Leontodon taraxacum</i>	—	—
Hazel, or Nut, common	<i>Corylus avellana</i>	21.	7.
Butchers' broom, common	<i>Ruscus aculeatus</i>	22.	3.

## MARCH.

<i>Crocus</i> , spring	<i>Crocus vernus</i>	3.	1.
— net-rooted	— reticulatus	—	—
Trichonema, channel-leaved	<i>Trichonema bulbocodium</i>	—	—
Cotton-grass, hares'-tail	<i>Eriophorum vaginatum</i>	—	—
Grass, early Knappia	<i>Knappia agrostidea</i>	—	2.
— annual meadow	<i>Poa annua</i>	—	—
Primrose, common	<i>Primula vulgaris</i>	5.	2.
Violet, sweet	<i>Viola odorata</i>	—	—
Elm, small-leaved	<i>Ulmus campestris</i>	—	2.
— cork-barked	— suberosa	—	—
— Dutch	— major	—	—
— broad-leaved, Wych-hazel	— montana	—	—
— wych	— glabra	—	—
Daffodil, common	<i>Narcissus pseudo-narcissus</i>	6.	1.
Squill, two-leaved	<i>Scilla bifolia</i>	—	—
Wood-rush, hairy	<i>Luciola pilosa</i>	6.	—
Mezereon, or Spurge-olive	<i>Daphne mezereum</i>	—	—
Spurge Laurel, common	— laureola	—	—
Chickweed, common	<i>Stellaria media</i>	10.	3.
Monse-ear Chickweed, little	<i>Cerastium semi-decandrum</i>	—	5.
Sloe, or black-thorn	<i>Prunus spinosa</i>	12.	1.
Cinquefoil, strawberry-leaved	<i>Potentilla fragariastrum</i>	—	3.
Hellebore, or bear's-foot, common	<i>Helleborus foetidus</i>	13.	5.
Dead Nettle, great henbit	<i>Lamium amplexicaule</i>	14.	1.

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Whitlow-grass, common	<i>Draba verna</i>	15.	1.
—— yellow alpine	—— <i>aizoides</i>	—	—
Hutchinsia-rock	<i>Hutchinsia petraea</i>	—	—
Shepherd's purse, common	<i>Thlaspi, bursa pastoris</i>	—	—
Ladies' smock, hairy	<i>Cardamine hirsuta</i>	—	2.
Colt's-foot, common	<i>Tussilago farfara</i>	19.	2.
Groundsel, common	<i>Senecio vulgaris</i>	—	—
Daisy, common	<i>Bellis perennis</i>	—	—
Spurge, red	<i>Euphorbia characias</i>	21.	1.
—— wood	—— <i>amygdaloides</i>	—	—
Alder, or Owler, common	<i>Alnus glutinosa</i>	—	4.
Hazel, or Nut, common	<i>Corylus avellana</i>	—	7.
Willow, purple	<i>Salix purpurea</i>	22.	2.
—— rose	—— <i>helix</i>	—	—
—— Boyton	—— <i>Lambertiana</i>	—	—
—— olive-leaved	—— <i>olei folia</i>	—	—
—— early prostrate	—— <i>prostrata</i>	—	—
Osier, auricled	—— <i>stipularis</i>	—	—
Butcher's-broom	<i>Ruscus aculeatus</i>	—	3.
Poplar, white, or Abele	<i>Populus alba</i>	—	7.
—— (or aspen), trembling	—— <i>tremula</i>	—	—
—— downy, or silver	—— <i>canescens</i>	—	—
—— black	—— <i>niger</i>	—	—
Yew tree, common	<i>Taxus baccata</i>	—	13.

## APRIL.

Chara, smooth	<i>Chara flexilis</i>	1.	1.
Water-starwort, vernal	<i>Callitriche verna</i>	—	2.
Ash, common	<i>Fraxinus excelsior</i>	2.	1.
—— simple leaved	—— <i>heterophylla</i>	—	—
Speedwell, field	<i>Veronica agrestis</i>	—	—
—— ivy-leaved	—— <i>hederifolia</i>	—	—
—— blunt-fingd., upright Chickweed	—— <i>triphyllus</i>	—	—
—— vernal	—— <i>verna</i>	—	—
Corn salad; Lamb's lettuce	<i>Fedia olitoria</i>	3.	1.
Trichonema, channel-leaved	<i>Trichonema(Ixia)bulbocodium</i>	—	—
Cotton-grass, hare's-tail	<i>Eriophorum vaginatum</i>	—	—
—— broad-leaved	—— <i>polystachion</i>	—	—
—— down-stalked	—— <i>pubescens</i>	—	—
—— common	—— <i>angustifolium</i>	—	—
Grass, early Knappia	<i>Knappia agrostidea</i>	—	2.
—— blue moor	<i>Sesleria cœrulea</i>	—	—
—— bulbous meadow	<i>Poa bulbosa</i>	—	—
—— annual meadow	—— <i>annua</i>	—	—
Water Blinks; Water Chickweed	<i>Montia fontana</i>	—	3.
Jagged Chickweed, umbelliferous	<i>Holosteum umbellatum</i>	—	—
Scorpion grass, trailing-hairy	<i>Myosotis intermedia</i>	5.	1.
—— yellow and blue	—— <i>versicolor</i>	—	—
Madwort, German	<i>Asperugo procumbens</i>	—	—
Primrose, common	<i>Primula vulgaris</i>	—	—
Oxlip	—— <i>elatior</i>	—	—
Cowslip, or Peigle	—— <i>veris</i>	—	—
Cyclamen, ivy-leaved	<i>Cyclamen hederifolium</i>	—	—
Violet, hairy	<i>Viola hirsuta</i>	—	—
—— sweet	—— <i>odorata</i>	—	—
—— marsh	—— <i>palustris</i>	—	—
—— dog's	—— <i>canina</i>	—	—
Gooseberry, common	<i>Ribes grossularia</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Elm, broad-leaved	<i>Ulmus montana</i>	5.	2.
Gentian, spring	<i>Gentiana verna</i>	—	—
— autumnal (b)	— <i>amarella</i> $\beta$	—	—
Chervil, wild, or Cow-parsley	<i>Chærophylum sylvestre</i>	—	—
Narcissus, pale ; Primrose peerless	<i>Narcissus biflorus</i>	6.	1.
Fritillary, common ; Snake's-head	<i>Fritillaria meleagris</i>	—	—
Tulip, wild	<i>Tulipa sylvestris</i>	—	—
Star of Bethlehem, yellow	<i>Ornithogalum luteum</i>	—	—
— common	— <i>umbellatum</i>	—	—
— drooping	— <i>nutans</i>	—	—
Squill, vernal	<i>Scilla verna</i>	—	—
— two-leaved	— <i>bifolia</i>	—	—
Wood-rush, hairy	<i>Luciola pilosa</i>	—	—
— field	— <i>campestris</i>	—	—
Meadow-saffron, common (b)	<i>Colchicum autumnale</i> $\beta$	—	3.
Knot-grass, common	<i>Polygonum aviculare</i>	8.	—
Moschatel, tuberous	<i>Adoxa moschatellina</i>	—	4.
Saxifrage, purple	<i>Saxifraga oppositifolia</i>	10.	2.
— rue-leaved	— <i>tridactylites</i>	—	—
Chickweed, common	<i>Stellaria media</i>	—	3.
Wood-sorrel, common	<i>Oxalis acetosella</i>	—	4.
Mouse-ear Chickweed, broad-leaved	<i>Cerastium vulgatum</i>	—	—
— little	— <i>semidecandrum</i>	—	—
Bullace, wild	<i>Prunus insititia</i>	12.	1.
Sloe, or Black-thorn	— <i>spinosa</i>	—	—
Pear, wild, or Iron-pear	<i>Pyrus communis</i>	—	2.
Service-tree, wild	— <i>terminalis</i>	—	—
Cinque-foil, spring	<i>Potentilla verna</i>	—	3.
— strawberry-leaved	— <i>fragariastrum</i>	—	—
Anemone, pasque-flower	<i>Anemone pulsatilla</i>	13.	5.
— wood	— <i>nemorosa</i>	—	—
— blue-mountain	— <i>apennina</i>	—	—
— yellow wood	— <i>ranunculoides</i>	—	—
Crowfoot, Pilewort	<i>Ranunculus ficaria</i>	—	—
— wood ; Goldilocks	— <i>auricomus</i>	—	—
Hellebore, green	<i>Helleborus viridis</i>	—	—
— stinking ; Com. Bear's-foot	— <i>foetidus</i>	—	—
Marigold, marsh	<i>Caltha palustris</i>	—	—
Ground pine, yellow bugle	<i>Ajuga chamæpitys</i>	14.	1.
— Ivy, or Ale-hoof	<i>Glechoma hederacea</i>	—	—
Dead-nettle, spotted	<i>Lamium maculatum</i>	—	—
— great henbit	— <i>amplexicaule</i>	—	—
Tooth-wort, greater	<i>Lathræa squamaria</i>	—	2.
Fig-wort, yellow	<i>Scrophularia vernalis</i>	—	—
Whitlow-grass, common	<i>Draba verna</i>	15.	1.
— yellow alpine	— <i>aizodes</i>	—	—
— speedwell-leaved	— <i>muralis</i>	—	—
Hutchinsia rock	<i>Hutchinsia petræa</i>	—	—
Shepherd's purse, perfoliate	<i>Thlaspi perfoliatum</i>	—	—
— common	— <i>bursa pastoris</i> .	—	—
Coral-wort, bulbiferous	<i>Dentaria bulbifera</i>	—	2.
Ladies' smock, hairy	<i>Cardamine hirsuta</i>	—	—
— meadow ; Cuckoo-flower]	— <i>pratensis</i>	—	—
— bitter	— <i>amara</i>	—	—
Winter-cress, early	<i>Barbarea præcox</i>	—	—
Wall-flower, wild	<i>Cheiranthus fruticulosus</i>	—	—
Wall-cress, common	<i>Arabis thaliana</i>	—	—
Turnip, common	<i>Brassica rapa</i>	—	—
Crane's Bill, common dove's foot	<i>Geranium molle</i>	16.	1.

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Fumitory, solid bulbous	<i>Fumaria solida</i>	17.	2.
Vetch, spring	<i>Vicia lathyroides</i>	—	4.
Dandelion, common	<i>Leontodon taraxacum</i>	19.	1.
Colt's-foot, common	<i>Tussilago farfara</i>	—	2.
Butterbur	— <i>petasites</i>	—	—
Groundsel, common	<i>Senecio vulgaris</i>	—	—
Daisy, common	<i>Bellis perennis</i>	—	—
Orchis, male	<i>Orchis mascula</i>	20.	1.
— spider	<i>Ophrys aranifera</i>	—	—
Spurge, wood	<i>Euphorbia amygdaloides</i>	21.	—
— red	— <i>characias</i>	—	—
Sedge, or <i>Carex</i> , loose, pendulous	<i>Carex strigosa</i>	—	3.
— spring	— <i>præcox</i>	—	—
— round-headed	— <i>pilulifera</i>	—	—
— glaucous, str.-leaved	— <i>stricta</i>	—	—
— great, common	— <i>riparia</i>	—	—
Box-tree, common	<i>Buxus sempervirens</i>	—	4.
Oak-tree, common	<i>Quercus robur</i>	—	7.
— downy	— <i>sessilifolia</i>	—	—
Beech, common	<i>Fagus sylvatica</i>	—	—
Birch, white	<i>Betula alba</i>	—	—
Hazel, or nut-tree, common	<i>Corylus avellana</i>	—	—
Willow, sharp-leaved, triandrous	<i>Salix lanceolata</i>	22.	2.
— broad-leaved	— <i>amygdalina</i>	—	—
— dark broad-leaved	— <i>nigricans</i>	—	—
— shining-leaved	— <i>nitens</i>	—	—
— Wulfenian	— <i>Wulfeniana</i>	—	—
— shining-dark-leaved	— <i>bicolor</i>	—	—
— apple-leaved	— <i>malifolia</i>	—	—
— dark-long-leaved	— <i>petiolaris</i>	—	—
— crack	— <i>fragilis</i>	—	—
— Bedford	— <i>Russelliana</i>	—	—
— rose	— <i>helix</i>	—	—
— Boyton	— <i>Lambertiana</i>	—	—
— fine, basket-Osier	— <i>Forbiana</i>	—	—
— green-leaved	— <i>rubra</i>	—	—
— broad-leaved monadelphous	— <i>Croweana</i>	—	—
— plum-leaved	— <i>prunifolia</i>	—	—
— bilberry-leaved	— <i>vacciniifolia</i>	—	—
— veiny-leaved	— <i>venulosa</i>	—	—
— broad-leaved mountain	— <i>Dicksoniana</i>	—	—
— folded-leaved	— <i>carinata</i>	—	—
— little-tree	— <i>arbuscula</i>	—	—
— early prostrate	— <i>prostrata</i>	—	—
— rosemary-leaved	— <i>rosmarinifolia</i>	—	—
— gray-sallow	— <i>cinerea</i>	—	—
— round-eared ; training-sallow	— <i>aurita</i>	—	—
— water-sallow	— <i>aquatica</i>	—	—
— quince-leaved sallow	— <i>cotinifolia</i>	—	—
— hairy-leaved sallow	— <i>hirta</i>	—	—
— green mountain do.	— <i>Andersoniana</i>	—	—
— withered-pointed do.	— <i>sphacelata</i>	—	—
— green round-leaved do.	— <i>caprea</i>	—	—
— long-leaved sallow	— <i>acuminata</i>	—	—
— common osier	— <i>viminialis</i>	—	—
— silver-leaved osier	— <i>Smithiana</i>	—	—
Butcher's broom ; Knee holly	<i>Ruscus aculeatus</i>	—	4.
Poplar ; Aspen	<i>Populus tremula</i>	—	5.
Mercury, perennial	<i>Mercurialis perennis</i>	—	2.
Yew-tree, common	<i>Taxus baccata</i>	—	12.

## MAY.

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
ail, common	Hippuris vulgaris	1.	1.
mooth	Chara flexilis	—	—
tarwort, vernal	Callitriche verna	—	2.
common, or Prim-print	Ligustrum vulgare	2.	1.
amon	Fraxinus excelsior	—	—
ple-leaved	— heterophylla	—	—
ill, smooth, Paul's Betony	Veronica serpyllifolia	—	—
male, or common	— officinalis	—	—
germander	— chamaedrys	—	—
mountain germander	— montana	—	—
procumbent field	— agrestis	—	—
wall, speedwell, chickweed	— arvensis	—	—
ivy-leaved, small henbit	— hederifolia	—	—
ort, common, Yorks-Sanicle	Pinguicula vulgaris	—	—
large-flowered	— grandiflora	—	—
grass, sweet-scented	Anthoxanthum odoratum	—	2.
ad, common, Lamb's lettuce	Fedia olitoria	3.	1.
Gladwin, stinking	Iris foetidissima	—	—
grass, downy-stalked	Eriophorum pubescens	—	—
sea-cat's tail	Phleum arenarium	—	2.
meadow, fox-tail	Alopecurus pratensis	—	—
water-hair	Aira aquatica	—	—
early-hair	— præcox	—	—
northern holy	Hierochloe borealis	—	—
wood melic	Melica uniflora	—	—
blue moor	Sesleria cærulea	—	—
ulbous meadow	Poa bulbosa	—	—
mooth-stalked meadow	— pratensis	—	—
annual meadow	— annua	—	—
common quaking	Briza media	—	—
water; water chickweed	Montia fontana	—	3.
l, four-leaved	Polycarpon tetraphyllum	—	—
uff, sweet	Asperula odorata	4.	1.
ow, Cross-wort	Galium cruciatum	—	—
grass, or Cleavers	— aparine	—	—
l, greater	Plantago major	—	—
wort, alpine	Epimedium alpinum	—	—
mantle, field, Parsley-piert	Alchemilla arvensis	—	—
common	Ilex aquifolium	—	2.
ort, procumbent	Sagina procumbens	—	—
sea	— maritima	—	—
annual, small-flowered	— apetala	—	—
ia, upright	Mænchia erecta	—	—
mossy	Tillæa muscosa	—	—
n-grass, tufted water	Myosotis cæspitosa	—	1.
— yellow and blue	— versicolor	—	—
— trailing hairy	— intermedia	—	—
ell, common, gray Millet	Lithospermum officinale	—	—
corn; bastard Alkanet	— arvense	—	—
creeping, or purple	— purpureo-cæruleum	—	—
t, evergreen	Anchusa sempervirens	—	—
ort, common	Pulmonaria officinalis	—	—
narrow-leaved	— angustifolium	—	—
y, common	Symphytum officinale	—	—
ie, common	Primula vulgaris	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Cowslip, common, or Peigle	<i>Primula veris</i>	5.	1.
Loosestrife, wood; yellow Pimpernel	<i>Lysimachia nemorum</i>	—	—
Violet, dog's	<i>Viola canina</i>	—	—
— cream-coloured	— <i>lactea</i>	—	—
— dwarf yellow spurred	— <i>flavicomis</i>	—	—
— yellow mountain	— <i>lutea</i>	—	—
— pansy. Heart's-ease	— <i>tricolor</i>	—	—
Honeysuckle, pale perfoliate	<i>Lonicera caprifolium</i>	—	—
Buckthorn, common	<i>Rhamnus catharticus</i>	—	—
— alder, berry-bearing Alder	— <i>frangula</i>	—	—
Spindle-tree, common. Prickwood	<i>Euonymus Europæus</i>	—	—
Currant, common	<i>Ribes rubrum</i>	—	—
— rock	— <i>petraeum</i>	—	—
— acid mountain	— <i>spicatum</i>	—	—
— tasteless mountain	— <i>alpinum</i>	—	—
— black	— <i>nigrum</i>	—	—
Periwinkle, lesser	<i>Vinca minor</i>	—	—
— greater	— <i>major</i>	—	—
Goosefoot, mercury	<i>Chenopodium, bonus Henricus</i>	—	2.
Gentian, autumnal (b)	<i>Gentiana amarella</i> β	—	—
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<b>UMBELLATE.</b>	<b>UMBELLIFERÆ.</b>	<b>N. S.</b>	
Sanicle, wood	<i>Sanicula Europæa</i>	—	—
Hedge-parsley, knotty	<i>Torilis nodosa</i>	—	—
Beaked-parsley, common	<i>Anthriscus vulgaris</i>	—	—
Chervil, wild; or Cow-parsley	<i>Chærophylum sylvestre</i>	—	—
Cicely, sweet	<i>Myrrhis odorata</i>	—	—
Earth-nut, or Pignut, common.	<i>Bunium flexuosum</i>	—	—
Water-parsnep, least	<i>Sium inundatum</i>	—	—
Alexanders, common	<i>Smyrniolum olusatrum</i>	—	—
Gout-weed, common; herb, Gerarde	<i>Ægopodium podagraria</i>	—	—
Spignel, Meu, or Bald-money	<i>Meum athamanticum</i>	—	—
Burnet Saxifrage, dwarf	<i>Pimpinella dioica</i>	—	—
White-rot, com. or Marsh-pennywort	<i>Hydrocotyle vulgaris</i>	—	—
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Guelder-rose, mealy; wayfaring-tree	<i>Viburnum lantana</i>	—	3.
Mouse-tail, common	<i>Myosurus minimus</i>	—	6.
Snow-flake, summer	<i>Leucojum æstivum</i>	6.	1.
Narcissus, poetic	<i>Narcissus poeticus</i>	—	—
— pale; Primrose peerless	— <i>biflorus</i>	—	—
Garlick, broad-leaved; Ramsons	<i>Allium ursinum</i>	—	—
Star of Bethlehem, common	<i>Ornithogalum umbellatum</i>	—	—
— drooping	— <i>nutans</i>	—	—
Squill, hare-bell; wild Hyacinth	<i>Scilla nutans</i>	—	—
Hyacinth, starch	<i>Hyacinthus racemosus</i>	—	—
Lily of the Valley	<i>Convallaria majalis</i>	—	—
Solomon's seal, angular	— <i>polygonatum</i>	—	—
— common	— <i>multiflora</i>	—	—
Rush, dense-headed	<i>Juncus capitatus</i>	—	—
Wood-rush, narrow-leaved, hairy	<i>Luciola Forsteri</i>	—	—
— great	— <i>sylvatica</i>	—	—
— field	— <i>campestris</i>	—	—
Barberry, common	<i>Berberis vulgaris</i>	—	—
Arrow-grass, sea	<i>Triglochin palustre</i>	—	3.
Meadow-saffron, common (b)	<i>Colchicum autumnale</i> β	—	—
Chickweed, winter-green. European	<i>Trientalis Europæa</i>	7.	1.
Whortleberry, black; Bilberry	<i>Vaccinium myrtillus</i>	8.	—
— bog; great Bilberry	— <i>uliginosum</i>	—	—
Maple, greater; Sycamore	<i>Acer pseudo-platanus</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
common	<i>Acer campestre</i>	8.	1.
ass, common	<i>Polygonum aviculare</i>	—	3.
aria, common, or True-love	<i>Paris quadrifolia</i>	—	4.
tell, tuberous	<i>Adoxa moschatellina</i>	—	—
rry, black	<i>Arbutus alpina</i>	10.	1.
saxifrage, alternate-leaved	<i>Chrysoplenium alternifolium</i>	—	2.
— opposite-leaved	— <i>oppositifolium</i>	—	—
ge, white-meadow	<i>Saxifraga granulata</i>	—	—
rue-leaved	— <i>tridactylites</i>	—	—
mossy alpine	— <i>muscoides</i>	—	—
tufted	— <i>cæspitosa</i>	—	—
involute alpine	— <i>affinis</i>	—	—
mossy; Ladies' cushion	— <i>hypnoides</i>	—	—
web-foot-leaved	— <i>pedatifida</i>	—	—
ort, wood	<i>Stellaria nemorum</i>	—	3.
common chickweed	— <i>media</i>	—	—
greater	— <i>holostea</i>	—	—
lesser	— <i>graminea</i>	—	—
ort, plantain-leaved	<i>Arenaria trinervis</i>	—	—
- vernal	— <i>verna</i>	—	—
sorrel, common	<i>Oxalis acetosella</i>	—	4.
— yellow, procumbent	— <i>corniculata</i>	—	—
s, rock; red German catch-fly	<i>Lychnis viscaria</i>	—	—
red	— <i>dioica</i>	—	—
ear chickweed, broad-leaved	<i>Cerastium vulgatum</i>	—	—
— narrow-ditto	— <i>viscosum</i>	—	—
— four-cleft	— <i>tetrandrum</i>	—	—
— field	— <i>arvense</i>	—	—
acca, common	<i>Asarum Europæum</i>	11.	.
; bird	<i>Prunus padus</i>	12.	—
wild	— <i>cerasus</i>	—	—
ree, wild	— <i>domestica</i>	—	—
orn, White-thorn, or May	<i>Mespilus oxycantha</i>	—	2.
; common	— <i>germanica</i>	—	—
ee, wild. Iron-pear	<i>Pyrus communis</i>	—	—
tree, wild, or Crab-tree	— <i>malus</i>	—	—
tree, wild	— <i>torminalis</i>	—	—
— true	— <i>domestica</i>	—	—
ain-ash; Roan-tree	— <i>aucuparia</i>	—	—
— bastard	— <i>pinnatifida</i>	—	—
beam-tree	— <i>aria</i>	—	—
cinnamon	<i>Rosa cinnamomea</i>	—	3.
erry	<i>Rubus idæus</i>	—	—
le, dwarf-crimson	— <i>arcticus</i>	—	—
erry, wood	<i>Fragaria vesca</i>	—	—
foil, spring	<i>Potentilla verna</i>	—	—
— three-toothed	— <i>tridentata</i>	—	—
, common; herb-Bennet	<i>Geum urbanum</i>	—	—
berries, black; herb-Christopher	<i>Actæa spicata</i>	13.	1.
line, common	<i>Chelidonium majus</i>	—	—
d poppy, violet	<i>Glaucium violaceum</i>	—	—
hoary-dwarf	<i>Cistus marifolius</i>	—	—
entire-leaved	<i>Pæonia corallina</i>	—	4.
one, Pasque-flower	<i>Anemone pulsatilla</i>	—	5.
ant's eye	<i>Adonis autumnalis</i>	—	—
ot, grassy	<i>Ranunculus gramineus</i>	—	—
- wood; Goldilocks	— <i>auricomus</i>	—	—
- alpine, white	— <i>alpestris</i>	—	—
- bulbous; Buttercups	— <i>bulbosus</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Crowfoot, small-flowered	<i>Ranunculus parviflorus</i>	13:	A.
— ivy	— <i>hederaceus</i>	—	—
— white floating	— <i>aquaticus</i>	—	—
Globe-flower, mountain	<i>Trollius Europæus</i>	—	—
Hellebore; green	<i>Helleborus viridis</i>	—	—
Marsh-marigold, common, (b)	<i>Caltha palustris</i> β	—	—
— creeping	— <i>radicans</i>	—	—
Bugle, common	<i>Ajuga reptans</i>	14.	1.
— yellow; ground-pine	— <i>chamæpitys</i>	—	—
Ground-ivy, Gill, or Ale-hoof	<i>Glechoma hederacea</i>	—	—
Dead-nettle, white, or Archangel	<i>Lamium album</i>	—	—
— red, or Archangel	— <i>purpureum</i>	—	—
— cut-leaved, or Archangel	— <i>incisum</i>	—	—
— great henbit	— <i>amplexicaule</i>	—	—
Weasel-snout, yel.; yel. Archangel	<i>Galeobdolon luteum</i>	—	—
Bastard-balm, reddish	<i>Melittis melissophyllum</i>	—	—
— purple and white	— <i>grandiflora</i>	—	—
Snap-dragon, ivy-leaved	<i>Antirrhinum cymbalaria</i>	—	2.
Fig-wort, yellow	<i>Scrophularia vernalis</i>	—	—
Linnaea, two-flowered	<i>Linnaea borealis</i>	—	—
Whitlow-grass, simple-haired	<i>Draba hirta</i>	15.	1.
— twisted-podded	— <i>incana</i>	—	—
— speedwell-leaved	— <i>muralis</i>	—	—
Teesdalia, naked-stalked, irregular	<i>Teesdalia nudicaulis</i>	—	—
Shepherd's-purse, perfoliate	<i>Thlaspi perfoliatum</i>	—	—
— common	— <i>bursa pastoris</i>	—	—
Scurvy-grass, common	<i>Cochlearia officinalis</i>	—	—
— English	— <i>Anglica</i>	—	—
— Danish	— <i>Danica</i>	—	—
Horse-radish	— <i>armoracia</i>	—	—
Sea-kale	<i>Crambe maritima</i>	—	—
Coral-wort, bulbiferous	<i>Dentaria bulbifera</i>	—	2.
Ladies'-smock, impatient	<i>Cardamine impatiens</i>	—	—
— hairy	— <i>hirsuta</i>	—	—
— meadow; Cuckoo-flower	— <i>pratensis</i>	—	—
— bitter	— <i>amara</i>	—	—
Winter-cress, bitter; yel. Rocket	<i>Barbarea vulgaris</i>	—	—
— early	— <i>præcox</i>	—	—
Treacle-mustard, garlick	<i>Erysimum alliaria</i>	—	—
Wall-flower, wild	<i>Cheiranthus fruticulosus</i>	—	—
Shrubby-stock, hoary	<i>Matthiola incana</i>	—	—
Dame's Violet, common	<i>Hesperis matronalis</i>	—	—
Rock-cress, Bristol	<i>Arabis stricta</i>	—	—
Wall-cress, hairy	— <i>hirsuta</i>	—	—
— tower	— <i>turrita</i>	—	—
Tower-mustard, smooth	<i>Turritis glabra</i>	—	—
Rape, or Cole-seed	<i>Brassica napus</i>	—	—
Cabbage, sea	— <i>oleracea</i>	—	—
Charlock, wild mustard	<i>Sinapis arvensis</i>	—	—
Radish, sea	<i>Rhaphanus maritimus</i>	—	—
Stork's-bill, sea	<i>Erodium maritimum</i>	16.	2.
Crane's-bill, dusky	<i>Geranium phæum</i>	—	—
— knotty	— <i>nodosum</i>	—	—
— stinking; herb Robert	— <i>robertianum</i>	—	—
— shining	— <i>lucidum</i>	—	—
— common dove's-foot	— <i>molle</i>	—	—
— jagged-leaved	— <i>dissectum</i>	—	—
Mallow, common	<i>Malva sylvestris</i>	—	7.
Fumitory, solid-bulbous	<i>Fumaria bulbosa</i>	17.	2.

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Fumitory, yellow	<i>Fumaria lutea</i>	17.	2.
— common	— <i>officinalis</i>	—	—
Broom, common	<i>Spartium scoparium</i>	—	4.
Green-weed, hairy	<i>Genista pilosa</i>	—	—
— needle ; petty whin	— <i>Anglica</i>	—	—
Furze, common ; whin or goss	<i>Ulex Europæus</i>	—	—
Bitter-vetch, common ; heath-pea	<i>Orobus tuberosus</i>	—	—
— wood	— <i>sylvaticus</i>	—	—
Vetchling, crimson ; grass-vetch	<i>Lathyrus nissolia</i>	—	—
Vetch, common	<i>Vicia sativa</i>	—	—
— spring	— <i>lathyroides</i>	—	—
— common bush	— <i>sepium</i>	—	—
Bird's-foot, common	<i>Ornithopus perpusillus</i>	—	—
Horse-shoe-vetch, tufted	<i>Hippocrepis comosa</i>	—	—
Trefoil, white ; Dutch clover	<i>Trifolium repens</i>	—	—
— subterraneous	— <i>subterraneum</i>	—	—
— honeysuckle ; pur. Clover	— <i>pratense</i>	—	—
— rough, rigid	— <i>scabrum</i>	—	—
Bird's-foot-trefoil, slender	<i>Lotus angustissimus</i>	—	—
Medick, black ; nonsuch	<i>Medicago lupulina</i>	—	—
— spotted	— <i>maculata</i>	—	—

## COMPOUND FLOWERS.

Goat's-beard, purple  
Dandelion, common  
Hawk-weed, common Mouse-ear  
Groundsel, common, or *Silvestris*  
Flea-wort, mountain  
Leopard's-bane, great  
Daisy, common  
Wild Chamomile, common

Orchis, green-winged, meadow  
— early purple  
— great brown-winged  
— military  
— monkey  
— marsh palmate  
— drone  
Listera, or Bird's-nest  
Helleborine, narrow-leaved white  
Coral-root, spurless  
Carex, or Sedge, creeping, separate-headed }  
— prickly, separate-headed  
— little prickly  
— remote  
— soft brown  
— bracteated marsh  
— greater prickly  
— gray  
— great compound prickly  
— lesser paniced  
— fingered  
— dwarf-silvery  
— great pendulous  
— loose pendulous  
— pendulous wood  
— starved wood

## COMPOSITÆ, N. S.

*Tragopogon portifolius* 19. 1.  
~~*Leontodon taraxacum*~~  
*Hieracium pilosella*  
*Senecio vulgaris* 2.  
*Cineraria integrifolia*  
*Doronicum pardalianches*  
*Bellis perennis*  
*Matricaria chamomilla*

Orchis morio 20. 1.  
— *maculata*  
— *fusca*  
— *militaris*  
— *tephrosanthos*  
— *latifolia*  
*Ophrys fucifera*  
*Listeria nidus avis*  
*Epipactis ensifolia*  
*Corallorrhiza innata*  
Carex dioica 21. 3.  
— *Davalliana*  
— *stellulata*  
— *remota*  
— *intermedia*  
— *divisa*  
— *muricata*  
— *divulsa*  
— *vulpina*  
— *teretiuscula*  
— *digitata*  
— *clandestina*  
— *pendula*  
— *strigosa*  
— *sylvatica*  
— *depressa*

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Carex, pale	rex pallescens	21.	3.
— yellow	— flava	—	—
— round-headed	— pilulifera	—	—
— pink-leaved	— panicea	—	—
— glaucous heath	— recurva	—	—
— tufted bog	— cæspitosa	—	—
— slender-spiked	— acuta	—	—
— lesser common	— paludosa	—	—
— great common	— riparia	—	—
— short-spiked bladder	— vesicaria	—	—
— slender-beaked bottle	— ampullacea	—	—
— hairy	— hirta	—	—
Bryony, red-berried	Bryonia dioica	—	5.
Cuckoo-pint, common, Wake-robin	Arum maculatum	—	7.
Oak, sessile-fruited	Quercus sessiliflora	—	—
Chestnut, sweet	Fagus castanea	—	—
Beech, common	— sylvatica	—	—
Birch, common	Betula alba	—	—
— dwarf	— nana	—	—
Hornbeam, common	Carpinus betulus	—	—
Scotch Fir	Pinus sylvestris	—	8.
Willow, long-leaved triandrous	Salix triandra	22.	2.
— short-leaved triandrous	— Hoffmanniana	—	—
— sharp-leaved triandrous	— lanceolata	—	—
— almond-leaved triandrous	— amygdalina	—	—
— tea-leaved	— phyllicifolia	—	—
— dark upright	— Borreriana	—	—
— Davallian	— Davalliana	—	—
— Wulfenian	— Wulfeniana	—	—
— four-ranked	— tetrapla	—	—
— shining dark-green	— bicolor	—	—
— thin-leaved	— tenuifolia	—	—
— yellow ; or golden Osier	— vitellina	—	—
— white welsh, or varnished	— decipiens	—	—
— crack	— fragilis	—	—
— Bedford	— Russelliana	—	—
— green-leaved Osier	— rubra	—	—
— broad-leaved monadelphous	— Croweana	—	—
— plum-leaved	— prunifolia	—	—
— veiny-leaved	— venulosa	—	—
— green whortle-leaved	— myrsinites	—	—
— glaucous-mountain	— glauca	—	—
— downy-mountain	— arenaria	—	—
— silky-sand	— argentea	—	—
— fishy	— foetida	—	—
— dwarf, common	— repens	—	—
— brownish dwarf	— fusca	—	—
— trailing silky	— incubacea	—	—
— rusty-branched	— Doniana	—	—
— round-eared, or trailing Sallow	— aurita	—	—
Sallow, hairy-branched	— hirta	—	—
— silky rock	— rupestris	—	—
— great mountain	— Andersoniana	—	—
— glaucous mountain	— Fosteriana	—	—
— withered pointed	— sphacelata	—	—
Osier, common	— viminalis	—	—
— silky-leaved	— Smithiana	—	—
Willow, common white	— alba	—	—
Crow-berry ; black, or Crake-berry	Empetrum nigrum	—	3.

English Names.	Latin Names.	Class.	Order.
oe, common-white	Viscum album	22.	4.
-thorn, or sea Buckthorn	Hippophae rhamnoides	—	—
weet, or Dutch Myrtle	Myrica gale	—	—
oot, mountain	Rhodiola rosea	—	7.
ry, perennial	Mercurialis perennis	—	8.
r, common	Juniperus communis	—	13.
dwarf	— nana	—	—

JUNE.

-tail, common	Hippuris vulgaris	1.	1.
smooth	Chara flexilis	—	—
great transparent	— translucens	—	—
-starwort, autumnal	Callitriche autumnalis	—	2.
common; Print, or Primprint	Ligustrum vulgare	2.	1.
iter's nightshade, common	Circaea lutetiana	—	—
vell, smooth; Paul's Betony	Veronica serpyllifolia	—	—
- Brooklime	— beccabunga	—	—
- male, or common	— officinalis	—	—
- little hairy	— hirsuta	—	—
- germander, wildgermander	— chamaedrys	—	—
- mountain germander	— montana	—	—
- procumbent field	— agrestis	—	—
wort, pale	Pinguicula lusitanica	—	—
- common; Yorksh. Sanicle	— vulgaris	—	—
rwort, greater	Utricularia vulgaris	—	—
weed, ivy-leaved	Lemna trisulca	—	—
- lesser	— minor	—	—
- gibbous	— gibba	—	—
wild-English	Salvia verbenaca	—	—
-grass, sweet-scented	Anthoxanthum odoratum	—	2.
in red	Valeriana rubra	3.	1.
small marsh	— dioica	—	—
great wild	— officinalis	—	—
lad, common; Lamb's lettuce	Fedia olitoria	—	—
- oval-fruited	— dentata	—	—
sh, black	Schoenus nigricans	—	—
sh, floating	Scirpus fluitans	—	—
- brown	— rufus	—	—
- wood; Millet Cyperus-grass	— sylvaticus	—	—
ush, creeping	Eleocharis palustris	—	—
grass, alpine	Eriophorum alpinum	—	—

TRUE GRASSES.	GRAMINA VERA.		
-grass, manured	Phalaris Canariensis	3.	2.
il-grass, common	Phleum pratense	—	—
grass, spreading	Milium effusum	—	—
ass, silky	Agrostis spica venti	—	—
- brown	— canina	—	—
ass, water	Aira aquatica	—	—
- turfy	— caespitosa	—	—
- smooth alpine	— alpina	—	—
- early	— praecox	—	—
- silver	— caryophyllea	—	—
ass, meadow	Holcus lanatus	—	—
- oat-like	— avenaceus	—	—
ass, northern	Hierochloe borealis	—	—
ass, wood	Melica uniflora	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Melic-grass, mountain	Melica nutans	3.	2.
Moor-grass, blue	Sesleria coerulea	—	—
Sweet-grass, floating	Glyceria fluitans	—	—
— hard	— rigida	—	—
Meadow-grass, flat-stalked	Poa compressa	—	—
— roughish	— trivialis	—	—
— smooth-stalked	— pratensis	—	—
— annual	— annua	—	—
— glaucous	— glauca	—	—
— wood	— nemoralis	—	—
Quaking-grass, common	Briza media	—	—
Cock's-foot-grass, rough	Dactylis glomerata	—	—
Dog's-tail-grass, crested	Cynosurus cristatus	—	—
Fescue-grass, sheep's	Festuca ovina	—	—
— hard	— duriuscula	—	—
— barren	— bromoides	—	—
— wall	— Myurus	—	—
— single-husked	— uniglumis	—	—
— spiked	— loliacea	—	—
— meadow	— pratensis	—	—
— tall	— elatior	—	—
Brome-grass, soft	Bromus mollis	—	—
— smooth	— racemosus	—	—
— barren	— sterilis	—	—
— upright, annual	— diandrus	—	—
Oat, wild or haver	Avena fatua	—	—
— bristle-pointed	— strigosa	—	—
— downy	— pubescens	—	—
Hare's-tail-grass, ovate	Lagurus ovatus	—	—
Reed, small	Arundo calamagrostis	—	—
— smallest close	— stricta	—	—
Darnel, perennial ; Rye-grass	Lolium perenne	—	—
Lyme-grass, wood	Elymus Europæus	—	—
Barley, wall, or mouse ; way Bennet	Hordeum murinum	—	—
— meadow	— pratense	—	—
— sea ; Squirrel-tail-grass	— maritimum	—	—
Wheat-grass, dwarf-sea	Triticum loliaceum	—	—
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All-seed, four-leaved	Polycarpon tetraphyllum	—	3.
Scabious, small	Scabiosa columbaria	4.	1.
Sherardia, blue ; little field-madder	Sherardia arvensis	—	—
Woodruff, small ; Squinancy-wort	Asperula cynanchica	—	—
Bed-straw, smooth heath	Galium saxatile	—	—
— upright	— erectum	—	—
— warty-fruited	— verrucosum	—	—
— smooth-fruited corn	— spurium	—	—
— wall	— Anglicum	—	—
— Goose-grass, or Cleavers	— aparine	—	—
Madder, wild	Rubia peregrina	—	—
Plantain, greater	Plantago major	—	—
— hoary	— media	—	—
— ribwort	— lanceolata	—	—
— buck's-horn ; Star of the earth	— coronopus	—	—
Chaff-weed, small ; bastard Pimpernel	Centunculus minimus	—	—
Burnet, great	Sanguisorba officinalis	—	—
Cornel-tree, wild ; Dog-wood	Cornus sanguinea	—	—
— dwarf	Cornus Suecica	—	—
Wall-pellitory, common	Parietaria officinalis	—	—
Ladies' mantle, common	Alchemilla vulgaris	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Ladies' mantle, field ; Parsley plant	<i>Alchemilla arvensis</i>	4.	1.
Buffonia, slender	<i>Buffonia tenuifolia</i>	—	2.
Pond-weed, close-leaved	<i>Potamogeton densum</i>	—	3.
— shining	— <i>lucens</i>	—	—
— curled, fr.-water Caltrops	— <i>crispum</i>	—	—
— flat-stalked	— <i>compressum</i>	—	—
Pearl-wort, procumbent	<i>Sagina procumbens</i>	—	—
— sea	— <i>maritima</i>	—	—
— annual, small-flowered	— <i>apetala</i>	—	—
Tillæa, mossy	<i>Tillæa muscosa</i>	—	—
Scorpion-grass, great water	<i>Myosotis palustris</i>	5.	1.
— tufted water	— <i>cæspitosa</i>	—	—
— upright wood	— <i>sylvatica</i>	—	—
— field	— <i>arvensis</i>	—	—
— yellow and blue	— <i>versicolor</i>	—	—
Gromwell, corn ; bastard Alkanet	<i>Lithospermum arvense</i>	—	—
Alkanet, common	<i>Anchusa officinalis</i>	—	—
— evergreen	— <i>sempervirens</i>	—	—
Hound's tongue, common	<i>Cynoglossum officinale</i>	—	—
— green-leaved	— <i>sylvaticum</i>	—	—
Lung-wort, narrow-leaved	<i>Pulmonaria angustifolia</i>	—	—
Comfrey, common	<i>Symphytum officinalis</i>	—	—
Borage, common	<i>Borago officinalis</i>	—	—
Madwort, German	<i>Asperugo procumbens</i>	—	—
Bugloss, small	<i>Lycopsis arvensis</i>	—	—
Viper's-bugloss, common	<i>Echium vulgare</i>	—	—
Primrose, bird's-eye	<i>Primula farinosa</i>	—	—
Buck-bean, common ; marsh Trefoil	<i>Menyanthes trifoliata</i>	—	—
Featherfoil, common ; water Violet	<i>Hottonia palustris</i>	—	—
Loosetrife, wood ; yellow Pimpernel	<i>Lysimachia nemorum</i>	—	—
— creeping ; Money-wort	— <i>nummularia</i>	—	—
Pimpernel, common scarlet	<i>Anagallis arvensis</i>	—	—
Bind-weed, small	<i>Convolvulus arvensis</i>	—	—
— sea	— <i>soldanella</i>	—	—
Jacob's ladder, blue ; Greek valerian	<i>Polemonium cæruleum</i>	—	—
Bell-flower, ivy-leaved	<i>Campanula hederacea</i>	—	—
Sheep's-bit or Scabious, common	<i>Jasione montana</i>	—	—
Violet, dog's	<i>Viola canina</i>	—	—
— dwarf, yellow-spurred	— <i>flavicomis</i>	—	—
— Pansy ; Heart's-ease	— <i>tricolor</i>	—	—
— yellow mountain, or Pansy	— <i>lutea</i>	—	—
Night-shade, deadly ; com. Dwale	<i>Atropa belladonna</i>	—	—
— woody ; Bitter-sweet	<i>Solanum dulcamara</i>	—	—
— common, or garden	— <i>nigrum</i>	—	—
Centaury, dwarf-tufted	<i>Erythræa littoralis</i>	—	—
Honey-suckle, pale perfoliate	<i>Lonicera caprifollum</i>	—	—
— common or Woodbine	— <i>periclymenum</i>	—	—
Currant, rock	<i>Ribes petraeum</i>	—	—
Sea-milkwort ; black Saltwort	<i>Glaux maritima</i>	—	—
Goosefoot, Mercury	<i>Chenopodium bonus Henricus</i>	—	2.
Gentian, dwarf	<i>Gentiana acaulis</i>	—	—
— autumnal	— <i>amarella, β</i>	—	—
UMBELLATE.		UMBELLIFERÆ, N. 8.	
Carrot, wild	<i>Daucus carota</i>	—	—
Bur-parsley, small	<i>Caucalis daucoides</i>	—	—
Hedge-parsley, knotted	<i>Torilis nodosa</i>	—	—
Shepherd's needle ; Venus's comb	<i>Scandix ; Pecten Veneris</i>	—	—
Garden Chervil	<i>Chærophylum sativum</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Cicely, or Cow-parsley, rough	Myrrhis temulenta	5.	2.
—— tawney-seeded	Myrrhis aurea	—	—
—— broad-leaved	—— aromatica	—	—
Earth-nut, or Pig-nut, common	Bunium flexuosum	—	—
Hemlock, common	Conium maculatum	—	—
Coriander, common	Coriandrum sativum	—	—
Water-drop-wort; Sulphur-wort	Oenanthe peucedanifolia	—	—
—— fine-leaved	—— phellandrium	—	—
Gout-weed, common; herb Gerarde	Ægopodium podagraria	—	—
Masterwort, great	Imperatoria ostruthium	—	—
Angelica, garden	Angelica archangelica	—	—
Spignel, Meu, or Bald-money	Meum athamanticum	—	—
Caraway, common	Carum carui	—	—
Burnet-saxifrage, dwarf	Pimpinella dioica	—	—
White-rot, com.; marsh Penny-wort	Hydrocotyle vulgaris	—	—
Hart-wort, small	Tordylium officinale	—	—
—— great	—— maximum	—	—
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Guelder-rose, common, Water-elder	Viburnum opulus	—	3.
Elder, common	Sambucus nigra	—	—
Bladder-nut, common	Staphylea pinnata	—	—
Flax, perennial blue	Linum perenne	5.	5.
—— purging; Mill-mountain	—— catharticum	—	—
Garlick, broad-leaved; Ramsons	Allium ursinum	6.	1.
—— chive	—— schœnoprassum	—	—
Star of Bethlehem, tall	Ornithogalum pyrenaicum	—	—
Spiderwort, mountain	Anthericum scrotinum	—	—
Solomon's seal, narrow-leaved	Convallaria verticillata	—	—
—— angular	—— polygonatum	—	—
—— common	—— multiflora	—	—
Sweet-flag, common	Acorus calamus	—	—
Rush, moss; Goose-corn	Juncus squarrosus	—	—
—— little bulbous	—— uliginosus	—	—
—— dense-headed	—— capitatus	—	—
—— sharp-flowered jointed	—— acutiflorus	—	—
Wood-rush, great	Luciola sylvatica	—	—
—— many-headed bog	—— congesta	—	—
Barberry, common	Berberis vulgaris	—	—
Mountain sorrel, kidney-shaped	Oxyria reniformis	—	2
Dock, curled	Rumex crispus	—	3.
—— common sorrel	—— acetosa	—	—
—— sheep's sorrel	—— acetosella	—	—
Scheuchzeria, marsh	Scheuchzeria palustris	—	—
Arrow-grass, marsh	Triglochin palustre	—	—
—— sea	—— maritimum	—	—
Water-plantain, star-headed	Alisma damasonium	—	4.
Chickweed, winter green, European	Trientalis Europæa	7.	1.
Willow-herb, alpine	Epilobium alpinum	8.	—
Whortle-berry, red; Cow-berry	Vaccinium Vitis idæa	—	—
—— marsh; Cranberry	—— oxycoccos	—	—
Menziezia, Scottish	Menziezia cœrulea	—	—
—— Irish	—— polifolia	—	—
Ling, or heath, common	Calluna vulgaris	—	—
Maple, common	Acer campestre	—	—
Bistort, or snake-weed, great	Polygonum bistorta	—	3.
—— alpine	—— viviparum	—	—
Knot-grass, common	—— aviculare	—	—
Buck-wheat, climbing; blk. bind-weed	—— convolvulus	—	—
Herb Paris, common	Paris quadrifolia	—	4
Flowering-rush, common	Botanus umbellatus	2.	3.

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Bird's nest, yellow	Monotropa Hypopitys	10.	1.
Andromeda, marsh ; wild rosemary	Andromeda polifolia	—	—
Bear-berry, red	Arbutus uva ursi	—	—
Saxifrage, kidney-leaved	Saxifraga geum	—	2.
— hairy, oval-leaved	— hirsuta	—	—
— London-pride	— umbrosa	—	—
— starry	— stellaris	—	—
— yellow mountain	— aizoides	—	—
— alpine brook	— rivularis	—	—
— dwarf-alpine	— pygmæa	—	—
— tufted-alpine	— cæspitosa	—	—
— hairy-alpine	— hirta	—	—
— involute-alpine	— affinis	—	—
— broad-petalled	— platypetala	—	—
— mossy, ladies'-cushion	— hypnoides	—	—
— long-stalked	— elongella	—	—
Pink, mountain	Dianthus cæsius	—	—
Catch-fly, English	Silene anglica	—	3.
— variegated	— quinquevulnera	—	—
— Nottingham	— nutans	—	—
Campion, moss	— acaulis	—	—
Stitchwort, wood	Stellaria nemorum	—	—
— common chickweed	— media	—	—
— glaucous marsh	— glauca	—	—
— bog	— uliginosa	—	—
— many-stalked	— scapigera	—	—
— alpine	— cerastoides	—	—
Sandwort, or sea chickweed	Arenaria peploides	—	—
— plantain-leaved	— trinervis	—	—
— fine-leaved	— tenuifolia	—	—
— vernal	— verna	—	—
— little red	— rubella	—	—
— level-topped	— fastigiata	—	—
— sea spurry	— marina	—	—
Navelwort, common	Cotyledon umbilicus	10.	4.
Stonecrop, biting ; wall pepper	Sedum acre	—	—
— hairy	— villosum	—	—
— thick-leaved, white	— dasyphyllum	—	—
Wood-sorrel, yellow procumbent	Oxalis corniculata	—	—
Cockle corn	Agrostemma githago	—	—
Lychnis, meadow ; ragged Robin	Lychnis flos cuculi	—	—
— rock ; red German catch-fly	— viscaria	—	—
Campion, red alpine	— alpina	—	—
— white	— dioica $\beta$	—	—
Mouse-ear chickweed, broad-leaved	Cerastium latifolium	—	—
— narrow-leaved	— viscosum	—	—
— four-cleft	— tetrandrum	—	—
— field	— arvense	—	—
— alpine	— alpinum	—	—
Agrimony, common	Agrimonia Eupatoria	11.	2.
Hawthorn, white thorn, or May	Mespilus oxyacantha	12.	—
Meadow-sweet ; Queen of the Meads.	Spiræa ulmaria	—	—
Rose, prickly, unexpanded	Rosa involuta	—	3.
— dwarf, hairy	— Doniana	—	—
— soft-leaved, round-fruited	— villosa	—	—
— downy-leaved, dog-rose	— tomentosa	—	—
— round-headed	— Sherardi	—	—
— sweet-brier, or eglantine	— rubiginosa	—	—
— small-flowered sweet-brier	— micrantha	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Rose, downy-stalked, dog-rose	<i>Rosa Borreri</i>	12.	3.
— trailing smooth-leaved	— <i>sarmentacea</i>	—	—
— bracteated downy	— <i>bractescens</i>	—	—
— thicket	— <i>dumentorum</i>	—	—
— downy-ribbed dog-rose	— <i>Forsteri</i>	—	—
— Irish	— <i>hibernica</i>	—	—
— common dog-rose	— <i>canina</i>	—	—
— close-styled dog-rose	— <i>systema</i>	—	—
Raspberry, common	<i>Rubus idæus</i>	—	—
Bramble, blue, or dew-berry	— <i>cæsius</i>	—	—
— dwarf crimson	— <i>arcticus</i>	—	—
— stone	— <i>saxatilis</i>	—	—
— mountain, or cloud-berry	— <i>chamæmorus</i>	—	—
Strawberry, wood	<i>Fragaria vesca</i>	—	—
— hautboy	— <i>elatior</i>	—	—
Cinquefoil, shrubby	<i>Potentilla fruticosa</i>	—	—
— silver-weed ; wild Tansy	— <i>anserina</i>	—	—
— strawberry-flowered	— <i>rupestris</i>	—	—
— hoary	— <i>argentea</i>	—	—
— saw-leaved, hairy	— <i>opaca</i>	—	—
— white	— <i>alba</i>	—	—
— common creeping	— <i>reptans</i>	—	—
— three-toothed	— <i>tridentata</i>	—	—
Tormentil, common, or septfoil	<i>Tormentilla officinalis</i>	—	—
— trailing	— <i>reptans</i>	—	—
<i>Avens</i> , common ; herb Bennet	<i>Geum urbanum</i>	—	—
— water	— <i>rivale</i>	—	—
Marsh-cinquefoil, purple	<i>Comarum palustre</i>	—	—
Bane-berries ; herb Christopher	<i>Actæa spicata</i>	13.	1.
Celandine, common	<i>Chelidonium majus</i>	—	—
Horned poppy, scarlet	<i>Glaucium phœniceum</i>	—	—
— violet	— <i>violaceum</i>	—	—
Poppy, long-rough-headed	<i>Papaver argemone</i>	—	—
— long-smooth-headed	— <i>dubium</i>	—	—
— common red	— <i>rhœas</i>	—	—
— yellow	— <i>cambricum</i>	—	—
Lime-tree, broad-leaved downy	<i>Tilia grandifolia</i>	—	—
Cistus, hoary dwarf	<i>Cistus marifolius</i>	—	—
— spotted annual	— <i>guttatus</i>	—	—
— ledum-leaved	— <i>ledifolius</i>	—	—
— white-mountain	— <i>polifolius</i>	—	—
Piony, entire-leaved	<i>Pæonia corallina</i>	—	4.
Larkspur, field	<i>Delphinium consolida</i>	—	—
Wolf'sbane, or Monk's-hood, com.	<i>Aconitum napellus</i>	—	—
Columbine, common	<i>Aquilegia vulgaris</i>	—	—
Meadow-rue, alpine	<i>Thalictrum alpinum</i>	—	5.
— lesser	— <i>minus</i>	—	—
— greater	— <i>majus</i>	—	—
— common	— <i>flavum</i>	—	—
Pheasant's-eye, corn <i>Adonis fl.</i>	<i>Adonis autumnalis</i>	—	—
Crowfoot, lesser spear-wort	<i>Ranunculus flammula</i>	—	—
— grassy	— <i>gramineus</i>	—	—
— water, celery-leaved	— <i>scleratus</i>	—	—
— pale hairy	— <i>hirsutus</i>	—	—
— creeping	— <i>repens</i>	—	—
— upright meadow	— <i>acris</i>	—	—
— corn	— <i>arvensis</i>	—	—
— small flowered	— <i>parviflorus</i>	—	—
— ivy	— <i>holatensis</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
ot, white floating	<i>Ranunculus aquatilis</i>	13.	5.
flower, mountain	<i>Trollius Europæus</i>	—	—
marigold, creeping	<i>Caltha radicans</i>	—	—
pyramidal	<i>Ajuga pyramidalis</i>	14.	1.
corn	<i>Mentha arvensis</i>	—	—
henbit ; henbit dead-nettle	<i>Lamium amplexicaule</i>	—	—
d-balm, reddish	<i>Melittis melissophyllum</i>	—	—
r-rattle, common	<i>Rhinanthus crista-galli</i>	—	2.
wort, marsh ; tall red-rattle	<i>Pedicularis palustris</i>	—	—
— pasture, dwarf do.	— <i>sylvatica</i>	—	—
ragon, ivy-leaved	<i>Antirrhinum cymbalaria</i>	—	—
ax, common yellow	— <i>linaria</i>	—	—
- least	— <i>minus</i>	—	—
ove, purple	<i>Digitalis purpurea</i>	—	—
a, two-flowered	<i>Linnæa borealis</i>	—	—
rape, greater	<i>Orobanche major</i>	—	—
rocket, annual	<i>Vella annua</i>	15.	1.
ow-grass, simple-haired	<i>Draba hirta</i>	—	—
— twisted-podded	— <i>incana</i>	—	—
of pleasure, common	<i>Camelina sativa</i>	—	—
rwort, narrow-leaved	<i>Lepidium ruderales</i>	—	—
— hairy Mithridate	— <i>hirtum</i>	—	—
date mustard ; penny cress	<i>Thlaspi arvense</i>	—	—
erd's purse, alpine	— <i>alpestre</i>	—	—
— common	— <i>bursa-pastoris</i>	—	—
y-grass, Danish	<i>Cochlearia danica</i>	—	—
cress, common ; swine's cress	<i>Senebiera coronopus</i>	—	—
t, purple sea	<i>Cakile maritima</i>	—	—
le	<i>Crambe maritima</i>	—	—
r-smock, impatient	<i>Cardamine impatiens</i>	—	2.
— hairy	— <i>hirsuta</i>	—	—
r-cress, common	<i>Nasturtium officinale</i>	—	—
w cress, creeping	— <i>sylvestre</i>	—	—
— annual	— <i>terrestre</i>	—	—
— amphibious ; great wa- ter radish }	— <i>amphibium</i>	—	—
a-mustard, common	<i>Sisymbrium officinale</i>	—	—
er cress, bitter ; yellow rocket	<i>Barbarea vulgaris</i>	—	—
— early	— <i>præcox</i>	—	—
le-mustard, hare's-ear	<i>Erysimum orientale</i>	—	—
by stock, hoary	<i>Matthiola incana</i>	—	—
's-violet, common	<i>Hesperis matronalis</i>	—	—
r mustard, smooth	<i>Turritis glabra</i>	—	—
Navew, common	<i>Brassica campestris</i>	—	—
ge, sea	— <i>oleracea</i>	—	—
- Isle of Man	— <i>monensis</i>	—	—
ard, wild ; charlock	<i>Sinapis arvensis</i>	—	—
- white	— <i>alba</i>	—	—
- common	— <i>nigra</i>	—	—
- narrow-leaved wall	— <i>tenuifolia</i>	—	—
h wild ; jointed charlock	<i>Raphanus raphanistrum</i>	—	—
- sea	— <i>maritimus</i>	—	—
's bill, hemlock	<i>Erodium cicutarium</i>	16.	2.
— musky	— <i>moschatum</i>	—	—
— sea	— <i>maritimum</i>	—	—
's-bill, dusky	<i>Geranium phæum</i>	—	5.
— knotty	— <i>nodosum</i>	—	—
— wood	— <i>sylvaticum</i>	—	—
— blue meadow	— <i>pratense</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Crane's-bill, stinking ; herb Robert	<i>Geranium robertianum</i>	16.	5.
— shining	— <i>lucidum</i>	—	—
— common dove's-foot	— <i>molle</i>	—	—
— small-flowered	— <i>pusillum</i>	—	—
— perennial dove's-foot	— <i>pyrenaicum</i>	—	—
— soft round-leaved	— <i>rotundifolium</i>	—	—
— jagged-leaved	— <i>dissectum</i>	—	—
— long stalked	— <i>columbinum</i>	—	—
Mallow, common	<i>Malva sylvestris</i>	—	7.
— dwarf	— <i>rotundifolia</i>	—	—
Fumitory, white climbing	<i>Fumaria claviculata</i>	17.	2.
— common	— <i>officinalis</i>	—	—
— ramping	— <i>capreolata</i>	—	—
Milkwort, common	<i>Polygala vulgaris</i>	—	3.
Broom, common	<i>Spartium scoparium</i>	—	4.
Green-weed, needle ; petty whin	<i>Genista anglica</i>	—	—
Rest-harrow, common or cammock	<i>Ononis arvensis</i>	—	—
Kidney-vetch, com. or Ladies' Finger	<i>Anthyllis vulneraria</i>	—	—
Bitter-vetch, common ; heath pea	<i>Orobus tuberosus</i>	—	—
— wood	— <i>sylvaticus</i>	—	—
— black	— <i>niger</i>	—	—
Vetchling, yellow	<i>Lathyrus Aphaca</i>	—	—
Vetch, common	<i>Vicia sativa</i>	—	—
— narrow-leaved crimson	— <i>angustifolia</i>	—	—
— hairy-flowered yellow	— <i>hybrida</i>	—	—
— common bush	— <i>sepium</i>	—	—
Tare, smooth	<i>Ervum tetraspermum</i>	—	—
— hairy	— <i>hirsutum</i>	—	—
Horse-shoe-vetch, tufted	<i>Hippocrepis comosa</i>	—	—
Saint-foin, common ; cock's-head	<i>Hedysarum onobrychis</i>	—	—
Milk-vetch, sweet ; wild liquorice	<i>Astragalus glycyphyllos</i>	—	—
— purple mountain	— <i>hypoglottis</i>	—	—
Trefoil, common melilot	<i>Trifolium officinale</i>	—	—
— bird's-foot	— <i>ornithopodioides</i>	—	—
— white ; Dutch clover	— <i>repens</i>	—	—
— suffocated	— <i>suffocatum</i>	—	—
— sulphur-coloured	— <i>ochroleucum</i>	—	—
— common clover ; honey- — suckle trefoil }	— <i>pratense</i>	—	—
— teasel-headed	— <i>maritimum</i>	—	—
— rough-rigid	— <i>scabrum</i>	—	—
— smooth, round-headed	— <i>glomeratum</i>	—	—
— soft-knotted	— <i>striatum</i>	—	—
— hop	— <i>procumbens</i>	—	—
— lesser yellow	— <i>minus</i>	—	—
— slender yellow	— <i>filiforme</i>	—	—
Bird's-foot trefoil, common	<i>Lotus corniculatus</i>	—	—
— slender	— <i>angustissimus</i>	—	—
Medick, purple ; or lucerne	<i>Medicago sativa</i>	—	—
— yellow sickle	— <i>falcata</i>	—	—
— black, or nonsuch	— <i>lupulina</i>	—	—
— spotted	— <i>maculata</i>	—	—
— little bur	— <i>minima</i>	—	—
St. John's-wort, hairy	<i>Hypericum hirsutum</i>	18.	4.
<b>COMPOUND FLOWERS.</b>		<b>COMPOSITÆ, N. S.</b>	
Goat's-beard, yellow	<i>Tragopogon pratensis</i>	19.	1
— purple	— <i>porrifolius</i>	—	—
Ox-tongue, bristly	<i>Picris echioides</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Dandelion, common	Leontodon taraxacum	19.	1.
— marsh	— palustris	—	—
Hawkweed, orange	Hieracium aurantiacum	—	—
— broad-leaved, wall	— murorum	—	—
— wood	— sylvaticum	—	—
— stained-leaved	— maculatum	—	—
Hawk's-beard, stinking	Crepis foetida	—	—
— small-flowered	— pulchra	—	—
— smooth; smooth suc- cory hawkweed }	— tectorum	—	—
— rough	— biennis	—	—
Cat's-ear, smooth	Hypochoeris glabra	—	—
— long-rooted	— radicata	—	—
Nipple-wort, common	Lapsana vulgaris	—	—
— dwarf; swine's succory	— pusilla	—	—
Thistle, welted	Carduus acanthoides	—	—
— slender-flowered	— tenuiflorus	—	—
— milk	— marianus	—	—
Plume-thistle, spear	Cnicus lanceolatus	—	—
— meadow	— pratensis	—	—
Carline thistle, common	Carlina vulgaris	—	2.
Cudweed, mountain	Gnaphalium dioicum	—	—
Ragwort, inelegant	Senecio squalidus	—	—
Ragwort great fen; bird's-tongue	Senecio paludosus	—	—
Flea-wort, marsh	Cineraria palustris	—	—
— mountain	— integrifolia	—	—
Daisy, common	Bellis perennis	—	—
Ox-eye; great white; moon daisy	Chrysanthemum leucanthemum	—	—
— yellow; corn marigold	— segetum	—	—
Feverfew, common	Pyrethrum Parthenium	—	—
Wild chamomile, common	Matricaria chamomilla	—	—
Chamomile, corn	Anthemis arvensis	—	—
— stinking mayweed	— cotula	—	—
Yarrow, or milfoil, common	Achillea millefolium	—	—
Knapweed, black	Centaurea nigra	—	3.
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Orchis, butterfly	Orchis bifolia	20.	1.
— green-winged meadow	— morio	—	—
— dwarf dark-winged	— ustulata	—	—
— white cluster-rooted	— albida	—	—
— frog	— viridis	—	—
— marsh palmate	— latifolia	—	—
— spotted palmate	— maculata	—	—
— aromatic palmate	— conopsea	—	—
— green man	Aceras anthropophora	—	—
— green musk	Herminium monorchis	—	—
— fly	Ophrys muscifera	—	—
— drone	— fucifera	—	—
Twayblade, common	Listera ovata	—	—
Listera, bird's nest	— nidus avis	—	—
Helleborine, purple-leaved	Epipactis purpurata	—	—
— large white	— grandiflora	—	—
— narrow-leaved white	— ensifolia	—	—
— purple	— rubra	—	—
Coral-root, spurless	Corallorrhiza innata	—	—
Ladies' slipper, common	Cypripedium calceolus	—	2.
Spurge, caper	Euphorbia lathyris	21.	1.
— cypress	— cyparissias	—	—
— Irish; makinboy	— hiberna	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Cat's-tail, or reed-mace, lesser	<i>Typha angustifolia</i>	21.	3.
Carex, or sedge, creeping separate-headed	<i>Carex dioica</i>	—	—
— prickly separate-headed	— <i>Davalliana</i>	—	—
— flea	— <i>pulicaris</i>	—	—
— few-flowered	— <i>pauciflora</i>	—	—
— little prickly	— <i>stellulata</i>	—	—
— white	— <i>curta</i>	—	—
— elongated	— <i>elongata</i>	—	—
— oval spiked	— <i>ovalis</i>	—	—
— remote	— <i>remota</i>	—	—
— axillary clustered	— <i>axillaris</i>	—	—
— sea	— <i>arenaria</i>	—	—
— soft brown	— <i>intermedia</i>	—	—
— bracteated marsh	— <i>divisa</i>	—	—
— greater prickly	— <i>muricata</i>	—	—
— great paniced	— <i>paniculata</i>	—	—
— great pendulous	— <i>pendula</i>	—	—
— pendulous wood	— <i>sylvatica</i>	—	—
— starved wood	— <i>depauperata</i>	—	—
— short brown-spiked	— <i>phæostachya</i>	—	—
— bastard cyperus	— <i>pseudo-cyperus</i>	—	—
— black	— <i>atrata</i>	—	—
— pale	— <i>pallescens</i>	—	—
— yellow	— <i>flava</i>	—	—
— tawny	— <i>fulva</i>	—	—
— long-bracteated	— <i>extensa</i>	—	—
— loose	— <i>distans</i>	—	—
— green-ribbed	— <i>binervis</i>	—	—
— larger downy-fruited	— <i>tomentosa</i>	—	—
— pink-leaved	— <i>panicca</i>	—	—
— glaucous heath	— <i>recurva</i>	—	—
— rigid	— <i>rigida</i>	—	—
— tufted bog	— <i>cæspitosa</i>	—	—
— smooth-stalked, beaked	— <i>lævigata</i>	—	—
— hairy	— <i>hirta</i>	—	—
— rye	— <i>secalina</i>	—	—
— dotted	— <i>stictocarpa</i>	—	—
— narrow-leaved	— <i>angustifolia</i>	—	—
— slender-leaved	— <i>filiformis</i>	—	—
Plantain shore-weed	<i>Littorella lacustris</i>	—	—
Nettle, Roman	<i>Urtica pilulifera</i>	—	—
— small	— <i>urens</i>	—	—
Bryony, red-berried	<i>Bryonia dioica</i>	—	5.
Willow, sweet bay	<i>Salix pentandria</i>	22.	2.
— thin-leaved	— <i>tenuifolia</i>	—	—
— green whortle-leaved	— <i>myrsinites</i>	—	—
— least	— <i>herbacea</i>	—	—
— wrinkled	— <i>reticulata</i>	—	—
— downy mountain	— <i>arenaria</i>	—	—
Black Bryony, common	<i>Tamus communis</i>	—	6.
Orache, spreading halberd-leaved	<i>Atriplex patula</i>	23.	1.
— narrow-leaved	— <i>angustifolia</i>	—	—

## JULY.

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Chara, common	Chara vulgaris	1.	1.
— prickly	— hispida	—	—
— smooth	— flexilis	—	—
— great transparent	— translucens	—	—
Water-starwort, autumnal	Callitriche autumnalis	—	2.
Enchanter's nightshade, common	Circæa lutetiana	2.	1.
— mountain	— alpina	—	—
Speedwell, spiked	Veronica spicata	—	—
— welsh	— hybrida	—	—
— flesh-col. shrubby	— fruticulosa	—	—
— blue rock	— saxatilis	—	—
— alpine	— alpina	—	—
— brooklime	— beccabunga	—	—
— water; long-leaved brook- lime }	— anagallis	—	—
— narrow-leaved marsh	— scutellata	—	—
— procumbent field	— agrestis	—	—
Butterwort, pale	Pinguicula lusitanica	—	—
Bladderwort, greater	Utricularia vulgaris	—	—
— intermediate	— intermedia	—	—
— lesser	— minor	—	—
Duck-weed, lesser	Lemna minor	2.	1.
— gibbous	— gibba	—	—
— greater	— polyrrhiza	—	—
Gipsy-wort, com. water horehound	Lycopus europæus	—	—
Clary, meadow	Salvia pratensis	—	—
— wild English	— verbenaca	—	—
Twig-rush, prickly	Cladium mariscus	—	—
Valerian, red	Valeriana rubra	3.	1.
— heart-leaved	— pyrenaica	—	—
Corn-salad, oval-fruited	Fedia dentata	—	—
Iris, yellow-water	Iris pseud-acorus	—	—
Beak-rush, brown	Rhynchospora alba	—	—
Cyperus, sweet; English galingale	Cyperus longus	—	—
Club-rush, scaly-stalked	Scirpus cæspitosus	—	—
— floating	— fluitans	—	—
Bull-rush,	— lacustris	—	—
Club-rush bristled-stalked	— setaceus	—	—
— compressed	— caricinus	—	—
— brown	— rufus	—	—
— salt-marsh	— maritimus	—	—
— wood; millet Cyperus-grass	— sylvaticus	—	—
Spike-rush, creeping	Eleocharis palustris	—	—
— many-stalked	— multicaulis	—	—
Cotton-grass, alpine	Eriophorum alpinum	—	—
— slender mountain	— gracile	—	—
Mat-grass, common	Nardus stricta	—	—
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TRUE GRASSES.		GRAMINA VERA.	
Canary-grass, manured	Phalaris canariensis	3.	2.
— reed	— arundinacea	—	—
Cat's-tail-grass, com.; Timothy-grass	Phleum pratense	—	—
— alpine	— alpinum	—	—
— rough	— asperum	—	—
— purple-stalked	— Bochmeri	—	—
— Michelian	— Michelli	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class. Order.</i>	
Fox-tail.grass, alpine	<i>Alopecurus alpinus</i>	3.	2.
— slender	— <i>agrestis</i>	—	—
— bulbous	— <i>bulbosus</i>	—	—
— floating	— <i>geniculatus</i>	—	—
— orange-spiked	— <i>fulvus</i>	—	—
Beard-grass, annual	<i>Polypogon monspeliensis</i>	—	—
Millet-grass, spreading	<i>Milium effusum</i>	—	—
Bent-grass, silky	<i>Agrostis spica venti</i>	—	—
— brown	— <i>canina</i>	—	—
— bristle-leaved	— <i>setacea</i>	—	—
— fine	— <i>vulgaris</i>	—	—
— marsh	— <i>alba</i>	—	—
Dog's-tooth-grass, creeping	<i>Cynodon dactylon</i>	—	—
Finger-grass, cock's-foot	<i>Digitaria sanguinalis</i>	—	—
Panick-grass, rough	<i>Panicum verticillatum</i>	—	—
— green	— <i>viride</i>	—	—
— loose	— <i>crus-galli</i>	—	—
Hair-grass, crested	<i>Aira cristata</i>	—	—
— turfy	— <i>cæspitosa</i>	—	—
— smooth alpine	— <i>alpina</i>	—	—
— wavy mountain	— <i>flexuosa</i>	—	—
— gray	— <i>canescens</i>	—	—
— silver	— <i>caryophyllea</i>	—	—
Soft grass, meadow	<i>Holcus lanatus</i>	—	—
— creeping	— <i>mollis</i>	—	—
— oat-like	— <i>avenaceus</i>	—	—
Melic-grass, mountain	<i>Melica nutans</i>	—	—
Sweet-grass, reedy	<i>Glyceria aquatica</i>	—	—
— floating	— <i>fluitans</i>	—	—
— reflexed	— <i>distans</i>	—	—
— procumbent sea	— <i>procumbens</i>	—	—
— creeping sea	— <i>maritima</i> ,	—	—
Meadow-grass, flat-stalked	<i>Poa compressa</i>	—	—
— alpine	— <i>alpina</i>	—	—
— wavy	— <i>laxa</i>	—	—
— roughish	— <i>trivialis</i>	—	—
— annual	— <i>annua</i>	—	—
— glaucous	— <i>glauca</i>	—	—
— wood	— <i>nemorialis</i>	—	—
Heath-grass, decumbent	<i>Triodia decumbens</i>	—	—
Quaking-grass, small	<i>Briza minor</i>	—	—
Cock's-foot-grass, rough	<i>Dactylis glomerata</i>	—	—
Dog's-tail grass, crested	<i>Cynosurus cristatus</i>	—	—
— rough	— <i>echinatus</i>	—	—
Fescue-grass, viviparous	<i>Festuca vivipara</i>	—	—
— creeping	— <i>rubra</i>	—	—
— wall	— <i>myurus</i>	—	—
— hard	— <i>duriuscula</i>	—	—
— tall	— <i>gigantea</i>	—	—
— reed	— <i>calamaria</i>	—	—
— spiked	— <i>loliacea</i>	—	—
— meadow	— <i>pratensis</i>	—	—
— tall	— <i>elatior</i>	—	—
— slender wood	— <i>sylvatica</i>	—	—
— spiked heath	— <i>pinnata</i>	—	—
Brome-grass, smooth rye	<i>Bromus secalinus</i>	—	—
— downy rye	— <i>velutinus</i>	—	—
— corn	— <i>squarrosus</i>	—	—
— taper field	— <i>arvensis</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Brome-grass, upright perennial	<i>Bromus erectus</i>	3.	2.
— hairy wood	— <i>asper</i>	—	—
— barren	— <i>sterilis</i>	—	—
Oat, wild or haver	<i>Avena fatua</i>	—	—
— bristle-pointed	— <i>strigosa</i>	—	—
— grass, narrow-leaved	— <i>pratensis</i>	—	—
— great alpine	— <i>alpina</i>	—	—
— yellow	— <i>flavescens</i>	—	—
Reed, common	<i>Arundo phragmites</i>	—	—
— wood	— <i>epigejos</i>	—	—
— small	— <i>calamagrostis</i>	—	—
— sea; marram; sea mat-weed	— <i>arenaria</i>	—	—
Darnel, bearded	<i>Lolium temulentum</i>	—	—
— short-awned	— <i>arvense</i>	—	—
Lyme-grass, upright sea	<i>Elymus arenarius</i>	—	—
— pendulous sea	— <i>geniculatus</i>	—	—
Barley, wall, or mouse; Way Bennet	<i>Hordeum murinum</i>	—	—
— squirrel-tail grass	— <i>maritimum</i>	—	—
Wheat-grass, sea rushy	<i>Triticum junceum</i>	—	—
— creeping; couch-grass	— <i>repens</i>	—	—
— fibrous-rooted	— <i>caninum</i>	—	—
— crested	— <i>cristatum</i>	—	—
— dwarf sea	— <i>lohiaceum</i>	—	—
All-seed, four-leaved	<i>Polycarpon tetraphyllum</i>	—	3.
Teasel, manured, or fuller's	<i>Dipsacus fullonum</i>	4.	1.
— wild	— <i>sylvestris</i>	—	—
Scabious, field	<i>Scabiosa arvensis</i>	—	—
— small	— <i>columbaria</i>	—	—
Sherardia, blue; little field madder	<i>Sherardia arvensis</i>	—	—
Woodruff, small; Squinancy-wort	<i>Asperula cynanchica</i>	—	—
Bed-straw, white water	<i>Galium palustre</i>	—	—
— rough heath	— <i>Witheringii</i>	—	—
— smooth heath	— <i>saxatile</i>	—	—
— upright	— <i>erectum</i>	—	—
— bearded	— <i>aristatum</i>	—	—
— warty-fruited	— <i>verrucosum</i>	—	—
— rough-fruited corn	— <i>tricorne</i>	—	—
— smooth-fruited corn	— <i>spurium</i>	—	—
— least-mountain	— <i>pusillum</i>	—	—
— yellow	— <i>verum</i>	—	—
— great-hedge	— <i>mollugo</i>	—	—
— wall	— <i>anglicum</i>	—	—
— cross-leaved	— <i>boreale</i>	—	—
Goose-grass, or cleavers	— <i>aparine</i>	—	—
Madder-wild	<i>Rubia peregrina</i>	—	—
Gentianella, least	<i>Exacum filiforme</i>	—	—
Plantain, greater	<i>Plantago major</i>	—	—
— hoary	— <i>media</i>	—	—
— ribwort	— <i>lanceolata</i>	—	—
— buck's-horn; star of the earth	— <i>coronopus</i>	—	—
Chaff-weed, small; bastard Pimpernel	<i>Centunculus minimus</i>	—	—
Burnet, great	<i>Sanguisorba officinalis</i>	—	—
— oblong	— <i>media</i>	—	—
Cornel, dwarf	<i>Cornus succisa</i>	—	—
Wall-pellitory, common	<i>Parietaria officinalis</i>	—	—
Isnardia, marsh	<i>Isnardia palustris</i>	—	—
Ladies' mantle, common	<i>Alchemilla vulgaris</i>	—	—
— alpine	— <i>alpina</i>	—	—
— field; Parsley piert	— <i>arvensis</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Pond-weed, broad-leaved	Potamogeton natans	4.	3.
— various-leaved	— heterophyllum	—	—
— perfoliate	— perfoliatum	—	—
— long-leaved floating	— fluitans	—	—
— shining	— lucens	—	—
— lanceolate	— lanceolatum	—	—
— curled; fr.-water caltrops	— crispum	—	—
— flat-stalked	— compressum	—	—
— grassy	— gramineum	—	—
— small	— pusillum	—	—
Azalea, trailing	Azalea procumbens	5.	1.
Bind-weed, small	Convolvulus arvensis	—	—
— great	— sepium	—	—
— sea	— soldanella	—	—
Bell-flower, round-leaved	Campanula rotundifolia	—	—
— spreading	— patula	—	—
— rampion	— rapunculus	—	—
— peach-leaved	— persicifolia	—	—
— giant	— latifolia	—	—
— creeping	— rapunculoides	—	—
— nettle-leaved	— trachelium	—	—
— clustered	— glomerata	—	—
— ivy-leaved	— hederacea	—	—
Sheep's-bit, or Scabious, common	Jasione montana	—	—
Lobelia, water	Lobelia Dortmanna	—	—
Balsam, yellow; Touch-me-not	Impatiens noli-me-tangere	—	—
Violet, dog's	Viola canina	—	—
— pansy; Heart's-ease	— tricolor	—	—
— yellow mountain	— lutea	—	—
Mullein, great; high Taper	Verbascum thapsus	—	—
— white	— lychnitis	—	—
— yellow; hoary, or Norfolk	— pulverulentum	—	—
— dark or black	— nigrum	—	—
— moth	— blattaria	—	—
Thorn-apple, common	Datura stramonium	—	—
Henbane, common	Hyoscyamus niger	—	—
Night-shade, woody; bitter-sweet	Solanum Dulcamara	—	—
— common, or garden	— nigrum	—	—
Centaury, common	Erythraea centaurium	—	—
— dwarf tufted	— littoralis	—	—
— broad-leaved tufted	— latifolia	—	—
Brook-weed, com.; Water pimpernel	Samolus valerandi	—	—
Honey-suckle, or woodbine, common	Lonicera periclymenum	—	—
— upright fly	— Xylosteum	—	—
Knot-grass, whorled	Illecebrum verticillatum	—	—
Sea-milkwort, common; black saltwort	Glaux maritima	—	—
Bastard-toadflax, flax-leaved	Thesium linophyllum	—	—
Rupture-wort, smooth	Herniaria glabra	—	2.
— hairy	— hirsuta	—	—
Goose-foot, white	Chenopodium album	—	—
— round-leaved	— polyspermum	—	—
— sharp entire-leaved	— acutifolium	—	—
— sea	— maritimum	—	—
Saltwort, prickly	Salsola kali	—	—
— shrubby	— fruticosa	—	—
Gentian, dwarf	Gentiana acaulis	—	—
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<b>UMBELLATE.</b>		<b>UMBELLIFERÆ, N. S.</b>	
Eryngo, sea; Sea holly	Eryngium maritimum	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
field	<i>Eryngium campestre</i>	5.	2.
empire, sea ; Sea parsnep	<i>Echinophora spinosa</i>	—	—
wild	<i>Daucus carota</i>	—	—
sea-coast	— <i>maritimus</i>	—	—
ley, great	<i>Caucalis latifolia</i>	—	—
arsley, upright	<i>Torilis anthriscus</i>	—	—
— spreading	— <i>infesta</i>	—	—
d's-needle, common ; Venus's-comb }	<i>Scandix pecten-veneris</i>	—	—
er Cow-paraley, rough	<i>Myrrhis temulenta</i>	—	—
arsnep, broad-leaved	<i>Sium latifolium</i>	—	—
— narrow-leaved	— <i>angustifolium</i>	—	—
— procumbent	— <i>procumbens</i>	—	—
— whorled	— <i>verticillatum</i>	—	—
arley, com.; Lesser hemlock	<i>Æthusa cynapium</i>	—	—
k, common	<i>Conium maculatum</i>	—	—
dropwort, common	<i>Cenanthe fistulosa</i>	—	—
— parsley	— <i>pimpinelloides</i>	—	—
— hemlock	— <i>crocata</i>	—	—
— fine-leaved	— <i>phellandrium</i>	—	—
a, garden	<i>Angelica archangelica</i>	—	—
wild	— <i>sylvestris</i>	—	—
Scottish	<i>Ligusticum Scoticum</i>	—	—
Cornish	— <i>cornubiense</i>	—	—
common	<i>Anethum fœniculum</i>	—	—
saxifrage, common	<i>Pimpinella saxifraga</i>	—	—
— greater	— <i>magna</i>	—	—
ear common ; Thorow-wax	<i>Bupleurum rotundifolium</i>	—	—
— narrow-leaved	— <i>odontites</i>	—	—
raley, marsh	<i>Selinum palustre</i>	—	—
-wort, sea ; Hog's fennel	<i>Peucedanum officinale</i>	—	—
, common wild	<i>Pastinaca sativa</i>	—	—
arsnep, common ; Hogweed	<i>Heracleum spondylium</i>	—	—
ort, small	<i>Tordylium officinale</i>	—	—
— great	— <i>maximum</i>	—	—
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dwarf ; Danewort	<i>Sambucus ebulus</i>	—	3.
sk, French	<i>Tamarix gallica</i>	—	—
ort, sand	<i>Corrigiola littoralis</i>	—	—
common ; Sea gilliflower	<i>Statice armeria</i>	—	5.
blue spiked ; com. sea lavender	— <i>limonium</i>	—	—
matted, or sea lavender	— <i>reticulata</i>	—	—
ommon	<i>Linum usitatissimum</i>	—	—
arrow-leaved, pale	— <i>angustifolium</i>	—	—
erennial	— <i>perenne</i>	—	—
urging ; Mill-mountain	— <i>catharticum</i>	—	—
ia, procumbent	<i>Sibbaldia procumbens</i>	—	—
w, round-leaved	<i>Drosera rotundifolia</i>	—	6.
— long-leaved	— <i>longifolia</i>	—	—
— great	— <i>anglica</i>	—	—
; sand	<i>Allium arenarium</i>	6.	1.
— mountain	— <i>carinatum</i>	—	—
— streaked field	— <i>oleraceum</i>	—	—
— crow	— <i>vineale</i>	—	—
Bethlehem, tall	<i>Ornithogalum pyrenaicum</i>	—	—
phodel, Lancashire	<i>Narthecium ossifragum</i>	—	—
great sharp sea	<i>Juncus acutus</i>	—	—
hard	— <i>glaucus</i>	—	—
common	— <i>conglomeratus</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Rush, soft	<i>Juncus effusus</i>	6.	1.
— arctic	— <i>arcticus</i>	—	—
— three-leaved	— <i>trifidus</i>	—	—
— moss ; Goose-corn	— <i>squarrosus</i>	—	—
— round-fruited	— <i>compressus</i>	—	—
— mud	— <i>cœnosus</i>	—	—
— slender-spreading	— <i>Gesneri</i>	—	—
— toad	— <i>bufonius</i>	—	—
— little bulbous	— <i>uliginosus</i>	—	—
— whorl-headed	— <i>subverticillatus</i>	—	—
— dense-headed	— <i>capitatus</i>	—	—
— three-flowered	— <i>triglumis</i>	—	—
— clustered alpine	— <i>castaneus</i>	—	—
— sharp-flowered jointed	— <i>acutiflorus</i>	—	—
— shining-fruited jointed	— <i>lampocarpus</i>	—	—
Wood-rush, spiked	<i>Luciola spicata</i>	—	—
— curved mountain	— <i>arcuata</i>	—	—
Sea-heath, smooth	<i>Frankenia lævis</i>	—	—
— powdery	— <i>pulverulenta</i>	—	—
Purslane water	<i>Peplis portula</i>	—	—
Dock, bloody-veined ; $\beta$ green-veined	<i>Rumex sanguineus</i>	—	3.
— curled	— <i>crispus</i>	—	—
— sharp	— <i>acutus</i>	—	—
— broad-leaved	— <i>obtusifolius</i>	—	—
— golden	— <i>maritimus</i>	—	—
— yellow marsh	— <i>palustris</i>	—	—
— great water	— <i>hydrolapathum</i>	—	—
— sheep's sorrel	— <i>acetosella</i>	—	—
Arrow-grass, marsh	<i>Triglochin palustre</i>	—	—
— sea	— <i>maritimum</i>	6.	3.
Water plantain, greater	<i>Alisma plantago</i>	—	4.
— star-headed	— <i>damasonium</i>	—	—
— floating	— <i>natans</i>	—	—
Evening primrose, common	<i>Oenothera biennis</i>	8.	1.
Willow-herb, or French willow, rose- bay	<i>Epilobium angustifolium</i>	—	—
— great hairy ; codlins and cream	— <i>hirsutum</i>	—	—
— small flowered hoary	— <i>parviflorum</i>	—	—
— broad ; smooth-leaved	— <i>montanum</i>	—	—
— pale ; smooth-leaved	— <i>roseum</i>	—	—
— square-talked	— <i>tetragonum</i>	—	—
— round-stalked, marsh	— <i>palustre</i>	—	—
— chick-weed leaved	— <i>alsinifolium</i>	—	—
— alpine	— <i>alpinum</i>	—	—
Chlora, or yellow-wort, perfoliate	<i>Chlora perfoliata</i>	—	—
Menziesia, Scottish	<i>Menziesia cærulea</i>	—	—
— Irish	— <i>polifolia</i>	—	—
Ling, common	<i>Calluna vulgaris</i>	—	—
Heath, cross-leaved	<i>Erica tetralix</i>	—	—
— fine-leaved	— <i>cinerea</i>	—	—
— cornish	— <i>vagans</i>	—	—
Persicaria, spotted	<i>Polygonum persicaria</i>	—	3.
— amphibious	— <i>amphibium</i>	—	—
— pale-flowered	— <i>lapathifolium</i>	—	—
Bistort, alpine	— <i>viviparum</i>	—	—
Knot-grass	— <i>aviculare</i>	—	—
Buck-wheat, or brank	— <i>fagopyrum</i>	—	—
— climbing ; black bind-weed	— <i>convolvulus</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Waterwort, small	<i>Elatine tripetala</i>	8.	4.
Flowering-rush, common	<i>Butomus umbellatus</i>	9.	3.
Winter-green, round-leaved	<i>Pyrola rotundifolia</i>	10.	1.
—— intermediate	—— <i>media</i>	——	——
—— lesser	—— <i>minor</i>	——	——
—— serrated	—— <i>secunda</i>	——	——
—— single-flowered	—— <i>uniflora</i>	——	——
Saxifrage, starry	<i>Saxifraga stellaris</i>	——	2.
—— clustered alpine	—— <i>nivalis</i>	——	——
—— yellow mountain	—— <i>aizoides</i>	——	——
—— drooping bulbous	—— <i>cernua</i>	——	——
—— alpine brook	—— <i>rivularis</i>	——	——
—— dwarf alpine	—— <i>pygmæa</i>	——	——
—— hairy alpine	—— <i>hirta</i>	——	——
Knawel, annual	<i>Scleranthus annuus</i>	——	——
Pink, Deptford	<i>Dianthus armeria</i>	——	——
—— proliferous	—— <i>prolifer</i>	——	——
—— clove, or carnation	—— <i>caryophyllus</i>	——	——
—— maiden	—— <i>deltoides</i>	——	——
—— mountain	—— <i>cæsius</i>	——	——
Catchfly, English	<i>Silene anglica</i>	——	3.
—— variegated	—— <i>quinquevulnera</i>	——	——
—— campion, bladder	—— <i>inflata</i>	——	——
—— striated corn	—— <i>conica</i>	——	——
—— night-flowering	—— <i>noctiflora</i>	——	——
—— common, or Lobel's	—— <i>armeria</i>	——	——
—— Nottingham	—— <i>nutans</i>	——	——
—— Spanish	—— <i>otites</i>	——	——
—— moss campion	—— <i>acaulis</i>	——	——
Stitchwort, glaucous marsh	<i>Stellaria glauca</i>	——	——
Sandwort, sea	<i>Arenaria peploides</i>	——	——
—— thyme-leaved	—— <i>serpyllifolia</i>	——	——
—— vernal	—— <i>verna</i>	——	——
—— purple	—— <i>rubra</i>	——	——
—— sea spurrey	—— <i>marina</i>	——	——
Mossy cyphel; Dwarf cherleria	<i>Cherleria sedoides</i>	——	——
Navelwort, common; Penny-leaf	<i>Cotyledon umbilicus</i>	——	4.
—— greater yellow	—— <i>lutea</i>	——	——
Stonecrop, white English	<i>Sedum anglicum</i>	——	——
—— insipid yellow	—— <i>sexangulare</i>	——	——
—— hairy	—— <i>villosum</i>	——	——
—— white	—— <i>album</i>	——	——
—— crooked yellow	—— <i>reflexum</i>	——	——
—— glaucous yellow	—— <i>glaucum</i>	——	——
—— St. Vincent's rock	—— <i>rupestre</i>	——	——
—— Welsh rock	—— <i>Forsterianum</i>	——	——
Wood-sorrel, yellow procumbent	<i>Oxalis corniculata</i>	——	——
Cockle, corn	<i>Agrostemma githago</i>	——	——
Campion, red alpine	<i>Lychnis alpina</i>	——	——
—— white and blush	—— <i>dioica</i> $\beta$ . $\gamma$ .	——	——
Mouse-ear, chickweed, narrow-leaved	<i>Cerastium viscosum</i>	——	——
—— field	—— <i>arvense</i>	——	——
—— alpine	—— <i>alpinum</i>	——	——
—— broad-leaved	—— <i>latifolium</i>	——	——
—— water	—— <i>aquaticum</i>	——	——
Spurrey, corn	<i>Spergula arvensis</i>	——	——
—— knotted	—— <i>nodosa</i>	——	——
—— fringed awl-shaped	—— <i>subulata</i>	——	——
Loose-strife, purple	<i>Lythrum salicaria</i>	11.	1.

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Agrimony, common	Agrimonia eupatoria	11.	2.
Dyer's rocket; Yellow-weed or weld	Reseda luteola	—	3.
Wild mignonette; Base rocket	— lutea	—	—
Spiræa; willow-leaved	Spiræa salicifolia	12.	2.
Dropwort, common	— filipendula	—	—
Meadow-sweet; Queen of the mea- dows }	— ulmaria	—	—
Rose, red-fruited dwarf	Rosa rubella	—	3.
— Burnet	— spinosissima	—	—
— tall bristly	— gracilis	—	—
— Sabinian	— Sabini	—	—
— round-headed	— Sherardi	—	—
— Sweetbrier, or eglantine	— rubiginosa	—	—
— small-flowered sweet brier	— micrantha	—	—
— glaucous-leaved	— cæsia	—	—
" — trailing, smooth-leaved	— sarmentacea	—	—
— bracteated downy	— bractescens	—	—
— Irish	— Hibernica	—	—
Dog-rose, downy-leaved	— tomentos?	—	—
— downy-stalked	— Borreri	—	—
— downy-ribbed	— Forsteri	—	—
— common	— canina	—	—
— close-styled	— systyla	—	—
— white trailing	— arvensis	—	—
Bramble, common, or Blackberry	Rubus fruticosus	—	—
— plaited-leaved	— plicatus	—	—
— buckthorn-leaved	— rhamnifolius	—	—
— white-clustered	— leucostachys	—	—
— glandular	— glandulosus	—	—
— smooth-shining	— nitidus	—	—
— ovate hairy	— affinis	—	—
— red-fruited	— suberectus	—	—
— hazel-leaved	— corylifolius	—	—
— blue, or Dewberry	— cæsius	—	—
Strawberry, hautboy	Fragaria elatior	—	—
Silver-weed, or wild tansy	Potentilla anserina	—	—
Cinquefoil, hoary	— argentea	—	—
— orange alpine	— alpestris	—	—
— white	— alba	—	—
— common creeping	— reptans	—	—
Tormentil, common, or septfoil	Tormentilla officinalis	—	—
— trailing	— reptans	—	—
Avens, common; herb Bennet	Geum urbanum	—	—
— water	— rivale	—	—
— mountain, or white Dryas	Dryas octopetala	—	—
Marsh-cinquefoil, purple	Comarum palustre	—	—
Horned-poppy, yellow	Glaucium luteum	13.	1.
— scarlet	— phoeniceum	—	—
Poppy, round rough-headed	Papaver hybridum	—	—
— long rough-headed	— argemone	—	—
— long smooth-headed	— dubium	—	—
— common red; Corn-rose	— Rhœas	—	—
— white	— somniferum	—	—
Water-lily, great white	Nymphæa alba	—	—
— common yellow	Nuphar lutea	—	—
— least yellow	— pumila	—	—
Lime-tree, common smooth; Linden- tree }	Tilia Europæa	—	—
— broad-leaved downy	— grandifolia	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
spotted annual	<i>Cistus guttatus</i>	13.	1.
ledum-leaved	— <i>ledifolius</i>	—	—
dotted-leaved	— <i>surrejanus</i>	—	—
common dwarf	— <i>helianthemum</i>	—	—
downy-cupped	— <i>tomentosus</i>	—	—
white mountain	— <i>polifolius</i>	—	—
pur, field	<i>Delphinium consolida</i>	—	4.
bane, or Monk's-hood, common	<i>Aconitum napellus</i>	—	—
bine, common	<i>Aquilegia vulgaris</i>	—	—
— aloe, or Water-soldier	<i>Stratiotes aloides</i>	—	—
— ller's joy, common	<i>Clematis vitalba</i>	—	5.
ow-rue, lesser	<i>Thalictrum minus</i>	—	—
— greater	— <i>majus</i>	—	—
— common	— <i>flavum</i>	—	—
ant's-eye, corn; Adonis-flower	<i>Adonis autumnalis</i>	—	—
foot, lesser spear-wort	<i>Ranunculus flammula</i>	—	—
— great spear-wort	— <i>lingua</i>	—	—
— water, or celery-leaved	— <i>sceleratus</i>	—	—
— pale hairy	— <i>hirsutus</i>	—	—
— creeping	— <i>repens</i>	—	—
— upright meadow	— <i>acris</i>	—	—
— ivy	— <i>hederaceus</i>	—	—
alpine	<i>Ajuga alpina</i>	14.	1.
under, wood; Wood sage	<i>Teucrium scorodonia</i>	—	—
— water	— <i>scordium</i>	—	—
— wall	— <i>chamaedrys</i>	—	—
int, or Nep, common	<i>Nepeta cataria</i>	—	—
in, common	<i>Verbena officinalis</i>	—	—
nint	<i>Mentha arvensis</i>	—	—
-nettle, common	<i>Galeopsis tetrahit</i>	—	—
— downy	— <i>villosa</i>	—	—
— large-flowered; Bee- nettle	— <i>versicolor</i>	—	—
y wood	<i>Betonica officinalis</i>	—	—
adwort, hedge	<i>Stachys sylvatica</i>	—	—
— corn	— <i>arvensis</i>	—	—
horehound, stinking	<i>Ballota nigra</i>	—	—
e horehound, common	<i>Marrubium vulgare</i>	—	—
erwort, common	<i>Leonurus cardiaca</i>	—	—
ram, common	<i>Origanum vulgare</i>	—	—
e, wild (many varieties)	<i>Thymus serpyllum</i>	—	—
- basil	— <i>acinos</i>	—	—
int, common	— <i>calamintha</i>	—	—
cap, common	<i>Scutellaria galericulata</i>	—	—
— lesser	— <i>minor</i>	—	—
eal, com.; Slough-heal	<i>Prunella vulgaris</i>	—	—
a, alpine	<i>Bartsia alpina</i>	—	2.
- yellow viscid	— <i>viscosa</i>	—	—
- red; Red eyebright	— <i>odontites</i>	—	—
w rattle, large bushy	<i>Rhinanthus major</i>	—	—
ight, common	<i>Euphrasia officinalis</i>	—	—
wheat, crested	<i>Melampyrum cristatum</i>	—	—
— purple	— <i>arvense</i>	—	—
— common yellow	— <i>pratense</i>	—	—
— wood	— <i>sylvaticum</i>	—	—
-wort, marsh; Tall red rattle	<i>Pedicularis palustris</i>	—	—
— pasture; dwarf do.	— <i>sylvatica</i>	—	—
dragon, ivy-leaved	<i>Antirrhinum cymbalaria</i>	—	—
— round-leaved Fluellin	— <i>spurius</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Snapdragon, sharp-pointed	<i>Antirrhinum elatine</i>	14.	2.
Toad-flax, creeping pale blue	— <i>repens</i>	—	—
— common yellow	— <i>linaria</i>	—	—
Snapdragon, least	— <i>minus</i>	—	—
— great	— <i>majus</i>	—	—
— lesser	— <i>orontium</i>	—	—
Fig-wort, knotty-rooted	<i>Scrophularia nodosa</i>	—	—
— water; Water betony	— <i>aquatica</i>	—	—
— halm-leaved	— <i>scorodonia</i>	—	—
Foxglove, purple	<i>Digitalis purpurea</i>	—	—
Sibthorpia, creeping; Cornish money- wort	<i>Sibthorpia Europæa</i>	—	—
Mudwort, common	<i>Limosella aquatica</i>	—	—
Broom-rape, greater	<i>Orobanche major</i>	—	—
— tall	— <i>elatio</i>	—	—
— lesser	— <i>minor</i>	—	—
— red fragrant	— <i>rubra</i>	—	—
— purple	— <i>cærulea</i>	—	—
Awlwort, water	<i>Subularia aquatica</i>	15.	1.
Pepperwort, broad-leaved	<i>Lepidium latifolium</i>	—	—
— common Mithridate	— <i>campestre</i>	—	—
Mithridate mustard; Penny-cress	<i>Thlaspi arvense</i>	—	—
Shepherd's purse, alpine	— <i>alpestre</i>	—	—
Wart-cress, common; Swine's-cress	<i>Seebiera coronopus</i>	—	—
— lesser	— <i>didyma</i>	—	—
Candy-tuft, bitter	<i>Iberis amara</i>	—	—
Woad, dyer's	<i>Isatis tinctoria</i>	—	—
Sea-rocket, purple	<i>Cakile maritima</i>	—	—
Water-cress, common	<i>Nasturtium officinale</i>	—	2.
Yellow-cress, creeping	— <i>sylvestre</i>	—	—
— annual	— <i>terrestre</i>	—	—
— amphibious	— <i>amphibium</i>	—	—
Hedge-mustard, common	<i>Sisymbrium officinale</i>	—	—
— br.-leaved London rocket	— <i>irio</i>	—	—
— fine-leaved, or flix-weed	— <i>sophia</i>	—	—
Winter-cress, bitter; Yellow-rocket	<i>Barbarea vulgaris</i>	—	—
— early	— <i>præcox</i>	—	—
Treacle-mustard, worm-seed	<i>Erysimum cheiranthoides</i>	—	—
Rock-cress, alpine	<i>Arabis hispida</i>	—	—
— fringed	— <i>ciliata</i>	—	—
Wild navew, common	<i>Brassica campestris</i>	—	—
Cabbage, Isle of Man	— <i>monensis</i>	—	—
Mustard, common	<i>Sinapis nigra</i>	—	—
Wall-mustard, narrow-leaved	— <i>tenuifolia</i>	—	—
Radish, wild; Jointed charlock	<i>Raphanus raphanistrum</i>	—	—
Stork's bill, hemlock	<i>Erodium cicutarium</i>	16.	2.
— musky	— <i>moschatum</i>	—	—
— sea	— <i>maritimum</i>	—	—
Crane's-bill, knotty	<i>Geranium nodosum</i>	—	5.
— wood	— <i>sylvaticum</i>	—	—
— meadow blue	— <i>pratense</i>	—	—
— stinking; Herb Robert	— <i>robertianum</i>	—	—
— shining	— <i>lucidum</i>	—	—
— common dove's-foot	— <i>molle</i>	—	—
— small-flowered	— <i>pusillum</i>	—	—
— perennial dove's-foot	— <i>pyrenaicum</i>	—	—
— soft round-leaved	— <i>rotundifolium</i>	—	—
— jagged-leaved	— <i>dissectum</i>	—	—
— long-stalked	— <i>columbinum</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
bill, bloody	<i>Geranium sanguineum</i>	16.	5.
nallow, common	<i>Althæa officinalis</i>	—	7.
common	<i>Malva sylvestris</i>	—	—
dwarf	— <i>rotundifolia</i>	—	—
musk	— <i>moschata</i>	—	—
allow, sea	<i>Lavatera arborea</i>	—	—
ry, white climbing	<i>Fumaria claviculata</i>	17.	2.
common	— <i>officinalis</i>	—	—
ry, ramping	<i>Fumaria capreolata</i>	—	—
rt, common	<i>Polygala vulgaris</i>	—	3.
weed, dyer's; wood waxe	<i>Genista tinctoria</i>	—	4.
row, common; cammock	<i>Ononis arvensis</i>	—	—
vetch, com.; ladies' finger	<i>Anthyllis vulneraria</i>	—	—
	<i>Pisum maritimum</i>	—	—
ng, yellow	<i>Lathyrus aphaca</i>	—	—
rough-podded	— <i>hirsutus</i>	—	—
yellow meadow	— <i>pratensis</i>	—	—
blue marsh	— <i>palustris</i>	—	—
ting-pea, narrow-leaved	— <i>sylvestris</i>	—	—
— broad-leaved	— <i>latifolius</i>	—	—
wood	<i>Vicia sylvatica</i>	—	—
tufted	— <i>cracca</i>	—	—
hairy-flowered, yellow	— <i>hybrida</i>	—	—
smooth-podded sea	— <i>lævigata</i>	—	—
rough-podded purple	— <i>bithynica</i>	—	—
mooth	<i>Ervum tetraspermum</i>	—	—
airy	— <i>hirsutum</i>	—	—
shoe-vetch, tufted	<i>Hippocrepis comosa</i>	—	—
in, common; cock's-head	<i>Hedysarum Onobrychis</i>	—	—
etch, purple mountain	<i>Astragalus hypoglottis</i>	—	—
hairy mountain	— <i>uralensis</i>	—	—
, common	<i>Trifolium officinale</i>	—	—
, bird's foot	— <i>ornithopodioides</i>	—	—
white; Dutch clover	— <i>repens</i>	—	—
suffocatum	— <i>suffocatum</i>	—	—
sulphur-coloured	— <i>ochroleucum</i>	—	—
common purple	— <i>pratense</i>	—	—
zig-zag	— <i>medium</i>	—	—
teasel headed	— <i>maritimum</i>	—	—
starry-headed	— <i>stellatum</i>	—	—
hare's-foot	— <i>arvense</i>	—	—
strawberry-headed	— <i>fragiferum</i>	—	—
hop	— <i>procumbens</i>	—	—
lesser yellow	— <i>minus</i>	—	—
slender yellow	— <i>filiforme</i>	—	—
foot-trefoil, common	<i>Lotus corniculatus</i>	—	—
— greater	— <i>major</i>	—	—
— spreading	— <i>decumbens</i>	—	—
s, purple or Lucerne	<i>Medicago sativa</i>	—	—
yellow sickle	— <i>falcata</i>	—	—
black or Nonesuch	— <i>lupulina</i>	—	—
flat-toothed	— <i>muricata</i>	—	—
little bur	— <i>minima</i>	—	—
m's wort, large-flowered	<i>Hypericum calycinum</i>	18.	4.
— Tutsan or Park leaves	— <i>Androsænum</i>	—	—
— square, St. Peter's-wort	— <i>quadrangulum</i>	—	—
— common perforated	— <i>perforatum</i>	—	—
— imperforate	— <i>dubium</i>	—	—
— trailing	— <i>humifusum</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
St. John's wort, mountain	<i>Hypericum montanum</i>	18.	4.
— hairy	— <i>hirsutum</i>	—	—
— small-upright	— <i>pulchrum</i>	—	—
— marsh	— <i>elodes</i>	—	—
Ox-tongue, bristly	<i>Picris echioides</i>	19.	1.
— hawkweed	— <i>hieracioides</i>	—	—
Sow-thistle, blue	<i>Sonchus cæruleus</i>	—	—
— tall marsh	— <i>palustris</i>	—	—
— common	— <i>oleraceus</i>	—	—
Wall-lettuce, ivy-leaved	<i>Prenanthes muralis</i>	—	—
Dandelion, common	<i>Leontodon Taraxacum</i>	—	—
— marsh	— <i>palustris</i>	—	—
Hawkbit, rough	<i>Apargia hispida</i>	—	—
— deficient	— <i>hirta</i>	—	—
Hawkweed, alpine single-flowered	<i>Hieracium alpinum</i>	—	—
— common mouse-ear	— <i>pilosella</i>	—	—
— branching mouse-ear	— <i>dubium</i>	—	—
— orange mouse-ear	— <i>auricula</i>	—	—
— orange	— <i>aurantiacum</i>	—	—
— stained-leaved	— <i>maculatum</i>	—	—
— wood	— <i>sylvaticum</i>	—	—
— lungwort	— <i>pulmonarium</i>	—	—
— glaucous hairy	— <i>Lawsoni</i>	—	—
— marsh succory-leaved	— <i>paludosum</i>	—	—
— soft-leaved	— <i>molle</i>	—	—
— small-toothed	— <i>denticulatum</i>	—	—
Hawk's-beard, stinking	<i>Crepis foetida</i>	—	—
— small-flowered	— <i>pulchra</i>	—	—
— smooth	— <i>tectorum</i>	—	—
— rough	— <i>biennis</i>	—	—
Cat's-car, spotted	<i>Hypochoeris maculata</i>	—	—
— smooth	— <i>glabra</i>	—	—
— long-rooted	— <i>radicata</i>	—	—
Nipple-wort, common	<i>Lapsana communis</i>	—	—
Succory, wild	<i>Cichorium intybus</i>	—	—
Burdock, common, or clot-bur	<i>Arctium lappa</i>	—	—
— woolly-headed	— <i>Bardana</i>	—	—
Saw-wort, common	<i>Serratula tinctoria</i>	—	—
— alpine	— <i>alpina</i>	—	—
Thistle, musk	<i>Carduus nutans</i>	—	—
— welted	— <i>acanthoides</i>	—	—
— slender-flowered	— <i>tenuiflorus</i>	—	—
— milk	— <i>marianus</i>	—	—
Plume-thistle, spear	<i>Cnicus lanceolatus</i>	—	—
— marsh	— <i>palustris</i>	—	—
— creeping	— <i>arvensis</i>	—	—
— branching bog	— <i>Forsteri</i>	—	—
— melancholy	— <i>heterophyllus</i>	—	—
— dwarf	— <i>acaulis</i>	—	—
Cotton-thistle, common	<i>Onopordum acanthium</i>	—	—
Hemp-agrimony, common	<i>Eupatorium cannabinum</i>	—	—
Tansy, common	<i>Tanacetum vulgare</i>	19.	2
Cudweed, Jersey	<i>Gnaphalium luteo-album</i>	—	—
— mountain	— <i>dioicum</i>	—	—
— dwarf-alpine	— <i>supinum</i>	—	—
— narrow-leaved	— <i>gallicum</i>	—	—
— least	— <i>minimum</i>	—	—
— common	— <i>germanicum</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
ard, Plowman's	<i>Conyza squarrosa</i>	19.	2.
ne, blue	<i>Erigeron acris</i>	—	—
- alpine	— <i>alpinus</i>	—	—
- pale-rayed mountain	— <i>uniflorus</i>	—	—
lsel, common	<i>Senecio vulgaris</i>	—	—
- stinking	— <i>viscosus</i>	—	—
- mountain	— <i>sylvaticus</i>	—	—
rt, inelegant	— <i>squalidus</i>	—	—
hoary	— <i>tenuifolius</i>	—	—
common	— <i>jacobæa</i>	—	—
marsh	— <i>aquaticus</i>	—	—
great fen; Bird's tongue	— <i>paludosus</i>	—	—
broad-leaved	— <i>saracenicus</i>	—	—
-rod, common	<i>Solidago virgaurea</i>	—	—
pane	<i>Inula Helenium</i>	—	—
ort, marsh	<i>Cineraria palustris</i>	—	—
common	<i>Bellis perennis</i>	—	—
, yellow; corn marigold	<i>Chrysanthemum segetum</i>	—	—
great white; moon daisy	— <i>Leucanthemum</i>	—	—
ow, common	<i>Pyrethrum Parthenium</i>	—	—
sea	— <i>maritimum</i>	—	—
hamomile, common	<i>Matricaria Chamomilla</i>	—	—
nile, sea	<i>Anthemis maritima</i>	—	—
corn	— <i>arvensis</i>	—	—
stinking mayweed	— <i>cotula</i>	—	—
ox-eye	— <i>tinctoria</i>	—	—
, sneeze-wort; goose-tongue	<i>Achillea Ptarmica</i>	—	—
common, or milfoil	— <i>millefolium</i>	—	—
or milfoil, woolly yellow	— <i>tomentosa</i>	—	—
eed, black	<i>Centaurea nigra</i>	—	3.
ne-bottle	— <i>cyanus</i>	—	—
eed, greater	— <i>scabiosa</i>	—	—
istle, Jersey	— <i>Isnardi</i>	—	—
- common	— <i>calcitrapa</i>	—	—
- yellow; St. Barnaby's } thistle	— <i>solstitialis</i>	—	—
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pyramidal	<i>Orchis pyramidalis</i>	20.	1.
lizard	— <i>hircina</i>	—	—
frog	— <i>viridis</i>	—	—
spotted palmate	— <i>maculata</i>	—	—
green musk	<i>Herminium monorchis</i>	—	—
bee	<i>Ophrys apifera</i>	—	—
late spider	— <i>arachnites</i>	—	—
ra, creeping	<i>Goodyera repens</i>	—	—
traces, proliferous	<i>Neottia gemmipara</i>	—	—
lade, heart-leaved mountain	<i>Listera cordata</i>	20.	1.
rine, broad-leaved	<i>Epipactis latifolia</i>	—	—
- marsh	— <i>palustris</i>	—	—
- purple	— <i>rubra</i>	—	—
his, least	<i>Malaxis paludosa</i>	—	—
- two-leaved	— <i>Lœselli</i>	—	—
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ort, common	<i>Aristolochia clematitis</i>	—	3.
purple	<i>Euphorbia peplis</i>	21.	1.
petty	— <i>peplus</i>	—	—
dwarf	— <i>exigua</i>	—	—
caper	— <i>lathyris</i>	—	—
sun; common wart-wort	— <i>helioscopia</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Spurge, upright warty	<i>Euphorbia stricta</i>	21.	1.
—— leafy branched	—— <i>esula</i>	—	—
—— cypress	—— <i>cyparissias</i>	—	—
Horned-pondweed, common	<i>Zannichellia palustris</i>	—	—
Cat's-tail or reed-mace, great	<i>Typha latifolia</i>	—	3.
—— lesser	—— <i>angustifolia</i>	—	—
—— dwarf	—— <i>minor</i>	—	—
Bur-reed, branched	<i>Sparganium ramosum</i>	—	—
—— unbranched	—— <i>simplex</i>	—	—
—— floating	—— <i>natans</i>	—	—
Carex or sedge, curved	<i>Carex incurva</i>	—	—
—— dense short-spiked	—— <i>speirostachya</i>	—	—
—— dwarf capillary	—— <i>capillaris</i>	—	—
—— loose-flowered alpine	—— <i>rariflora</i>	—	—
—— green and gold	—— <i>limosa</i>	—	—
—— scorched alpine	—— <i>ustulata</i>	—	—
—— black	—— <i>atrata</i>	—	—
—— russet	—— <i>pulla</i>	—	—
—— Oederian	—— <i>Oederi</i>	—	—
—— tawny	—— <i>fulva</i>	—	—
—— rigid	—— <i>rigida</i>	—	—
—— rye	—— <i>secalina</i>	—	—
—— dotted	—— <i>stictocarpa</i>	—	—
Nettle, Roman	<i>Urtica pilulifera</i>	—	4.
—— small	—— <i>urens</i>	—	—
—— great	—— <i>dioica</i>	—	—
Bryony, red-berried	<i>Bryonia dioica</i>	—	5.
Water-milfoil, spiked	<i>Myriophyllum spicatum</i>	—	7.
—— whorled	—— <i>verticillatum</i>	—	—
Arrow-head, common	<i>Sagittaria sagittifolia</i>	—	—
Salad-Burnet, common	<i>Poterium sanguisorba</i>	—	—
Willow, sweet bay-leaved	<i>Salix pentandra</i>	22.	2.
—— small-leaved shaggy	—— <i>Stuartiana</i>	—	—
—— common white	—— <i>alba</i>	—	—
Hop, common	<i>Humulus lupulus</i>	—	5.
Mercury, annual	<i>Mercurialis annua</i>	—	8.
Frog-bit, common	<i>Hydrocharis morsus-ranæ</i>	—	—
Orache, shrubby; sea-purslane	<i>Atriplex portulacoides</i>	23.	1.
—— frosted sea	—— <i>laciniata</i>	—	—
—— spreading halberd-leaved	—— <i>patula</i>	—	—
—— narrow-leaved	—— <i>angustifolia</i>	—	—

## AUGUST.

Jointed-glasswort, common	<i>Salicornia herbacea</i>	1.	1.
—— procumbent	—— <i>procumbens</i>	—	—
—— shrubby	—— <i>fruticosa</i>	—	—
Grass-wrack, common	<i>Zostera marina</i>	—	—
Chara, prickly	<i>Chara hispida</i>	—	—
—— smooth	—— <i>flexilis</i>	—	—
—— proliferous	—— <i>nidifica</i>	—	—
Water-starwort, autumnal	<i>Callitriche autumnalis</i>	—	2.
Enchanter's nightshade, mountain	<i>Circea alpina</i>	2.	1.
Speedwell, spiked	<i>Veronica spicata</i>	—	—
—— Welsh	—— <i>hybrida</i>	—	—
—— alpine	—— <i>alpina</i>	—	—
—— narrow-leaved marsh	—— <i>scutellata</i>	—	—
—— procumbent field	—— <i>agrestis</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Gipsy-wort, com. ; water-horehound	<i>Lycopus Europæus</i>	2.	1.
English clary, wild	<i>Salvia verbenaca</i>	—	—
Twig-rush, prickly	<i>Cladium mariscus</i>	—	—
Valerian, red	<i>Valeriana rubra</i>	3.	1.
Beak-rush, white	<i>Rhynchospora alba</i>	—	—
— brown	— <i>fusca</i>	—	—
Club-rush, chocolate-headed	<i>Scirpus pauciflorus</i>	—	—
— bull-rush	— <i>lacustris</i>	—	—
— glaucous	— <i>glaucus</i>	—	—
— bristle-stalked	— <i>setaceus</i>	—	—
— triangular	— <i>triqueter</i>	—	—
— blunt edged	— <i>carinatus</i>	—	—
— salt-marsh	— <i>maritimus</i>	—	—
Spike-rush, least	<i>Eleocharis acicularis</i>	—	—
Cotton-grass, round-headed	<i>Eriophorum capitatum</i>	—	—
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TRUE GRASSES.	GRAMINEÆ, N. S.		
Canary-grass, manured	<i>Phalaris canariensis</i>	—	2.
Cat's-tail-grass, common	<i>Phleum pratense</i>	—	—
Beard-grass, annual	<i>Polypogon monspeliensis</i>	—	—
— perennial	— <i>littoralis</i>	—	—
Millet-grass, panick	<i>Milium lendigerum</i>	—	—
Bent-grass, bristly-leaved	<i>Agrostis setacea</i>	—	—
— fine	— <i>vulgaris</i>	—	—
— marsh	— <i>alba</i>	—	—
Dog's tooth-grass, creeping	<i>Cynodon dactylon</i>	—	—
Finger-grass, cock's-foot	<i>Digitaria sanguinalis</i>	—	—
Panick-grass, rough	<i>Panicum verticillatum</i>	—	—
— green	— <i>viride</i>	—	—
Hair-grass, crested	<i>Aira cristata</i>	—	—
Melic-grass, purple	<i>Melica cærulea</i>	—	—
Sweet-grass, floating	<i>Glyceria fluitans</i>	—	—
— reflexed	— <i>distans</i>	—	—
— creeping-sea	— <i>maritima</i>	—	—
— procumbent sea	— <i>procumbens</i>	—	—
Meadow-grass, flat-stalked	<i>Poa compressa</i>	—	—
— alpine	— <i>alpine</i>	—	—
— roughish	— <i>trivialis</i>	—	—
— annual	— <i>annua</i>	—	—
Cock's-foot-grass, rough	<i>Dactylis glomerata</i>	—	—
Cord-grass, twin-spiked	<i>Spartina stricta</i>	—	—
Fescue-grass, tall	<i>Festuca gigantea</i>	—	—
Brome-grass, smooth rye	<i>Bromus secalinus</i>	—	—
— hairy wood	— <i>asper</i>	—	—
Hard-grass, sea	<i>Rottböllia incurvata</i>	—	—
Barley, wall or mouse ; way Bennet	<i>Hordeum murinum</i>	—	—
Wheat-grass, creeping ; couch-gr.	<i>Triticum repens</i>	—	—
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All-seed, four-leaved	<i>Polycarpon tetraphyllum</i>	3.	3.
Teasel, small ; shepherd's staff	<i>Dipsacus pilosus</i>	4.	1.
Scabious, devil's bit	<i>Scabiosa succisa</i>	—	—
— small	— <i>columbaria</i>	—	—
Sherardia, blue ; little field madder	<i>Sherardia arvensis</i>	—	—
Bed-straw, smooth heath	<i>Galium saxatile</i>	—	—
— rough marsh	— <i>uliginosum</i>	—	—
— gray, spreading	— <i>cinereum</i>	—	—
— bearded	— <i>aristatum</i>	—	—
— warty	— <i>verrucosum</i>	—	—
— least mountain	— <i>pusillum</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Bed-straw, yellow	<i>Galium verum</i>	4.	1.
— great hedge	— <i>mollugo</i>	—	—
Crude-grass, or cleavers	— <i>aparine</i>	—	—
Madder, wild	<i>Rubia peregrina</i>	—	—
Plantain, greater	<i>Plantago major</i>	—	—
— leafy	— <i>media</i>	—	—
— sea	— <i>maritima</i>	—	—
— buck's-horn; star of the earth }	— <i>coronopus</i>	—	—
Pellitory, common wall	<i>Parietaria officinalis</i>	—	—
Ladies' mantle, common	<i>Alchemilla vulgaris</i>	—	—
— field: parsley pier	— <i>arvensis</i>	—	—
Pond-weed, various-leaved	<i>Potamogeton heterophyllum</i>	—	3.
— perfoliate	— <i>perfoliatum</i>	—	—
— long-leaved floating	— <i>fluitans</i>	—	—
— lanceolate	— <i>lanceolatum</i>	—	—
Ruppia, sea: tassel pond-weed	<i>Ruppia maritima</i>	—	—
Pearl-wort, procumbent	<i>Sagina procumbens</i>	—	—
— sea	— <i>maritima</i>	—	—
Flax-seed, thyme-leaved	<i>Radiola millegrana</i>	—	—
Scorpion-grass, great: water	<i>Myosotis palustris</i>	5.	1.
— rock	— <i>alpestris</i>	—	—
— field	— <i>arvensis</i>	—	—
Gromwell, sea	<i>Lithospermum maritimum</i>	—	—
Buck-bean, fringed: fringed water- lily }	<i>Menyanthes nymphæoides</i>	—	—
Pimpernel, common scarlet	<i>Anagallis arvensis</i>	—	—
— bog	— <i>tenella</i>	—	—
Bindweed, great:	<i>Convolvulus sepium</i>	—	—
Bell-flower, round-leaved, or hare- bell }	<i>Campanula rotundifolia</i>	—	—
— spreading	— <i>patula</i>	—	—
— rampion	— <i>rapunculus</i>	—	—
Bell-flower, giant	<i>Campanula latifolia</i>	—	—
— creeping	— <i>rapunculoides</i>	—	—
— clustered	— <i>glomerata</i>	—	—
— ivy-leaved	— <i>hederacea</i>	—	—
— corn	— <i>hybrida</i>	—	—
Rampion, round-headed	<i>Phyteuma orbiculare</i>	—	—
Lobelia, acrid	<i>Lobelia urens</i>	—	—
Balsam, yellow: touch-me-not	<i>Impatiens noli-me-tangere</i>	—	—
Violet, dog's	<i>Viola canina</i>	—	—
— pansy: heart's-case	— <i>tricolor</i>	—	—
— yellow mountain	— <i>lutea</i>	—	—
Mullein, great; high taper	<i>Verbascum thapsus</i>	—	—
— white	— <i>lychnitis</i>	—	—
— dark or black	— <i>nigrum</i>	—	—
— large-flowered; primrose- leaved }	— <i>virgatum</i>	—	—
Nightshade, common, or garden	<i>Solanum nigrum</i>	—	—
Centaury, common	<i>Erythræa centaurium</i>	—	—
— dwarf-branched	— <i>pulchella</i>	—	—
Honeysuckle, or woodbine, common	<i>Lonicera periclymenum</i>	—	—
Rupture-wort, smooth	<i>Herniaria glabra</i>	—	2.
— hairy	— <i>hirsuta</i>	—	—
Goose-foot, upright	<i>Chenopodium urbicum</i>	—	—
— red	— <i>rubrum</i>	—	—
— many-spiked	— <i>botryoides</i>	—	—
— nettle-leaved	— <i>murale</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Goose-foot, maple-leaved	<i>Chenopodium hybridum</i>	5.	2.
— white	— album	—	—
— fig-leaved	— ficifolium	—	—
— oak-leaved	— glaucum	—	—
— stinking	— olidum	—	—
— round-leaved	— polyspermum	—	—
— sharp entire-leaved	— acutifolium	—	—
— sea	— maritimum	—	—
Bect, sea	<i>Beta maritima</i>	—	—
Salt-wort, shrubby	<i>Salsola fruticosa</i>	—	—
Dodder, greater	<i>Cuscuta Europæa</i>	—	—
— lesser	— epithymum	—	—
Felwort, marsh	<i>Swertia perennis</i>	—	—
Gentian, marsh ; calathian violet	<i>Gentiana pneumonanthe</i>	—	—
— small alpine	— nivalis	—	—
— autumnal	— amarella	—	—
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UMBELLATE.		UMBELLIFERÆ, N. S.	
Eringo, sea ; sea-holly	<i>Eryngium maritimum</i>	—	—
— field	— campestre	—	—
Carrot, sea-coast	<i>Daucus maritimus</i>	—	—
Shepherd's-needle, common	<i>Scandix Pecten-Veneris</i>	—	—
Water-parsnep, broad-leaved	<i>Sium latifolium</i>	—	—
— narrow-leaved	— angustifolium	—	—
— procumbent	— nodiflorum	—	—
— creeping	— repens	—	—
— whorled	— verticillatum	—	—
Hone-wort, hedge ; bastard stone } parsley }	<i>Sison amomum</i>	—	—
— corn	— segetum	—	—
Cowbane, water ; water hemlock	<i>Cicuta virosa</i>	—	—
Fool's-parsley, com. ; lesser hemlock	<i>Æthusa cynapium</i>	—	—
Water-dropwort, common	<i>Oenanthe fistulosa</i>	—	—
Sampire, sea	<i>Crithmum maritimum</i>	—	—
Smallage parsley ; wild celery	<i>Apium graveolens</i>	—	—
Angelica, garden	<i>Angelica Archangelica</i>	—	—
Fennel, common	<i>Meum fœniculum</i>	—	—
Stone-parsley, mountain	<i>Athamanta libanotis</i>	—	—
Burnet-saxifrage, common	<i>Pimpinella saxifraga</i>	—	—
— greater	— magna	—	—
Pepper-saxifrage, meadow	<i>Cnidium silaus</i>	—	—
Hare's-ear, slender	<i>Bupleurum tenuissimum</i>	—	—
Sulphur-wort, sea ; hog's fennel	<i>Peucedanum officinale</i>	—	—
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Strap-wort, sand	<i>Corrigiola littoralis</i>	—	3.
Thrift, common ; sea gilliflower	<i>Statice armeria</i>	—	5.
— blue spotted ; common sea } lavender }	— limonium	—	—
— matted	— reticulata	—	—
Flax, purging ; mill-mountain	<i>Linum catharticum</i>	—	—
Sun-dew, round-leaved	<i>Drosera rotundifolia</i>	—	6.
— long-leaved	— longifolia	—	—
— great	— anglica	—	—
Garlick, great round-headed	<i>Allium ampeloprasum</i>	6.	1.
Bog-asphodel, Lancashire	<i>Narthecium ossifragum</i>	—	—
Asparagus, common ; or sperage	<i>Asparagus officinalis</i>	—	—
Sea-rush, lesser sharp	<i>Juncus maritimus</i>	—	—
Rush, least	— filiformis	—	—
— arctic	— arcticus	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Rush, round-fruited	<i>Juncus compressus</i>	6.	1.
— toad	— <i>bufonius</i>	—	—
— whorl-headed	— <i>subverticillatus</i>	—	—
— two-flowered	— <i>biglumis</i>	—	—
— shining-fruited, jointed	— <i>lampocarpus</i>	—	—
— blunt-flowered, jointed	— <i>obtusiflorus</i>	—	—
Wood-rush, spiked	<i>Luciola spicata</i>	—	—
Purslane, water	<i>Peplis portula</i>	—	—
Dock, broad-leaved	<i>Rumex obtusifolius</i>	—	3.
— fiddle	— <i>pulcher</i>	—	—
— golden	— <i>maritimus</i>	—	—
— yellow marsh	— <i>palustris</i>	—	—
— great water	— <i>hydrolapathum</i>	—	—
Asphodel, marsh Scottish	<i>Tofieldia palustris</i>	—	—
Arrow-grass, sea	<i>Triglochin maritimum</i>	—	—
Water-plantain, floating	<i>Alisma natans</i>	—	4.
— lesser	— <i>ranunculoides</i>	—	—
Evening-primrose, common	<i>Oenothera biennis</i>	8.	1.
Willow-herb, rose-bay; Persian, or French willow }	<i>Epilobium angustifolium</i>	—	—
Chlora, or yellow-wort, perfoliate	<i>Chlora perfoliata</i>	—	—
Heath, cross-leaved	<i>Erica tetralix</i>	—	—
— fine-leaved	— <i>cinerea</i>	—	—
— Cornish	— <i>vagans</i>	—	—
Persicaria, amphibious	<i>Polygonum amphibium</i>	—	3.
— spotted	— <i>persicaria</i>	—	—
— pale-flowered	— <i>lapathifolium</i>	—	—
Knot-grass, common	— <i>aviculare</i>	—	—
Buck-wheat; or brank	— <i>fagopyrum</i>	—	—
Buck-wheat, climbing; bl. bind-weed	<i>Polygonum convolvulus</i>	—	3.
Water-wort, small	<i>Elatine tripetala</i>	—	4.
Winter-green, round-leaved	<i>Pyrola rotundifolia</i>	10.	1.
— intermediate	— <i>media</i>	—	—
Saxifrage, yellow-mountain	<i>Saxifraga aizoides</i>	—	2.
Knawel, perennial	<i>Scleranthus perennis</i>	—	—
Soap-wort, common	<i>Saponaria officinalis</i>	—	—
Pink, Deptford	<i>Dianthus armeria</i>	—	—
Campion, or catchfly, sea	<i>Silene maritima</i>	—	3.
— common; or Lobel's catchfly	— <i>armeria</i>	—	—
— Spanish	— <i>otites</i>	—	—
Chickweed, common	<i>Stellaria media</i>	—	—
Sand-wort, vernal	<i>Arenaria verna</i>	—	—
— fringed	— <i>ciliata</i>	—	—
— purple	— <i>rubra</i>	—	—
Orpine, or live-long	<i>Sedum telephium</i>	—	4.
Stonecrop, glaucous, yellow	— <i>glaucum</i>	—	—
Wood-sorrel, yellow procumbent	<i>Oxalis corniculata</i>	—	—
Campion, white	<i>Lychnis dioica</i>	—	—
Mouse-ear chickweed, narrow-leaved	<i>Cerastium viscosum</i>	—	—
Chickweed, field	— <i>arvense</i>	—	—
Spurrey, knotted	<i>Spergula nodosa</i>	—	—
— fringed awl-leaved	— <i>subulata</i>	—	—
Purple loosestrife, spiked	<i>Lythrum salicaria</i>	11.	1.
— hyssop-leaved	— <i>hyssopifolium</i>	—	—
Base rocket; wild mignonette	<i>Reseda lutea</i>	—	3.
Rose, Irish	<i>Rosa hibernica</i>	12.	3.
Blackberry, or common bramble	<i>Rubus fruticosus</i>	—	—
Bramble, buckthorn-leaved	— <i>rharnnifolius</i>	—	—
— white-clustered	— <i>leucostachys</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Bramble, glandular	<i>Rubus glandulosus</i>	12.	3.
— smooth shining	— <i>nitidus</i>	—	—
— ovate hairy	— <i>affinis</i>	—	—
— red-fruited	— <i>suberectus</i>	—	—
Strawberry, hautboy	<i>Fragaria elatior</i>	—	—
Cinquefoil, common creeping	<i>Potentilla reptans</i>	—	—
Avens, common; herb Bennet	<i>Geum urbanum</i>	—	—
— mountain, or white dryas	<i>Dryas octopetala</i>	—	—
Horned-poppy, yellow	<i>Glaucium luteum</i>	13.	1.
Line-tree, small-leaved	<i>Tilia parvifolia</i>	—	—
Cistus, dotted-leaved	<i>Cistus surrejanus</i>	—	—
— common dwarf	— <i>helianthemum</i>	—	—
Pheasant's-eye, corn; Adonis flower	<i>Adonis autumnalis</i>	—	5.
Crow-foot, lesser spear-wort	<i>Ranunculus flammula</i>	—	—
— water, celery-leaved	— <i>sceleratus</i>	—	—
— pale hairy	— <i>hirsutus</i>	—	—
— creeping	— <i>repens</i>	—	—
— ivy	— <i>hederaceus</i>	—	—
Germauder, water	<i>Teucrium scordium</i>	14.	1.
Vervain, common	<i>Verbena officinalis</i>	—	—
Mint, horse	<i>Mentha sylvestris</i>	—	—
— round-leaved	— <i>rotundifolia</i>	—	—
— spear	— <i>viridis</i>	—	—
— pepper	— <i>piperita</i>	—	—
— bergamot	— <i>citrata</i>	—	—
— hairy	— <i>hirsuta</i>	—	—
— bushy red	— <i>gentilis</i>	—	—
— narrow-leaved	— <i>gracilis</i>	—	—
— corn	— <i>arvensis</i>	—	—
— rugged field	— <i>agrostis</i>	—	—
Hemp-nettle, red	<i>Galeopsis ladanum</i>	—	—
— downy	— <i>villosa</i>	—	—
— common	— <i>tetrahit</i>	—	—
— large-flowrd.; bee-nettle	— <i>versicolor</i>	—	—
Wood betony	<i>Betonica officinalis</i>	—	—
Wound-wort, hedge	<i>Stachys sylvatica</i>	—	—
— ambiguous	— <i>ambigua</i>	—	—
— marsh	— <i>palustris</i>	—	—
— corn	— <i>arvensis</i>	—	—
Black-horehound, stinking	<i>Ballota nigra</i>	—	—
Mother-wort, common	<i>Leonurus cardiaca</i>	—	—
Wild basil, common	<i>Clinopodium vulgare</i>	—	—
Marjoram, common	<i>Origanum vulgare</i>	—	—
Thyme, wild	<i>Thymus serpyllum</i>	—	—
— basil	— <i>acinos</i>	—	—
Calamint, common	— <i>calamiutha</i>	—	—
— lesser	— <i>nepeta</i>	—	—
Skull-cap, common	<i>Scutellaria galericulata</i>	—	—
— lesser	— <i>minor</i>	—	—
Self-heal, or slough-heal, com.	<i>Prunella vulgaris</i>	—	—
Bartsia, yellow viscid	<i>Bartsia viscosa</i>	14.	2.
— red	— <i>odontites</i>	—	—
Eye-bright, common	<i>Euphrasia officinalis</i>	—	—
Cow-wheat, common yellow	<i>Melanpyrum pratense</i>	—	—
— wood	— <i>sylvaticum</i>	—	—
Snapdragon, ivy-leaved	<i>Antirrhinum cymbalaria</i>	—	—
— round-leaved fluellin	— <i>spurium</i>	—	—
— sharp-pointed fluellin	— <i>elatine</i>	—	—
Toad-flax, creeping pale-blue	— <i>repens</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Snapdragon, least	<i>Antirrhinum minus</i>	14.	2.
— great	— <i>majus</i>	—	—
— lesser	— <i>orontium</i>	—	—
Fig-wort, balm-leaved	<i>Scrophularia scorodonia</i>	—	—
Sibthorpia, creeping; Cornish money- wort	<i>Sibthorpia Europæa</i>	—	—
Mud-wort, common	<i>Limosella aquatica</i>	—	—
Broom-rape, tall	<i>Orobanche elatior</i>	—	—
— lesser	— <i>minor</i>	—	—
— branched	— <i>ramosa</i>	—	—
Alyssum, sweet	<i>Alyssum maritimum</i>	15.	1.
Shepherd's purse, common	<i>Thlaspi bursa-pastoris</i>	—	—
Scurvy-grass, Greenland	<i>Cochlearia grœnlandica</i>	—	—
Sea-rocket, purple	<i>Cakile maritima</i>	—	—
Wart-cress, common; swine's-cress	<i>Senebiera coronopus</i>	—	—
Ladies'-smock, daisy-leaved	<i>Cardamine bellidifolia</i>	—	2.
Yellow-cress, creeping	<i>Nasturtium sylvestre</i>	—	—
— annua	— <i>terrestre</i>	—	—
— amphibious	— <i>amphibium</i>	—	—
Hedge-mustard, broad	<i>Sisymbrium irio</i>	—	—
— fine-leaved; flxweed	— <i>sophia</i>	—	—
Winter-cress, bitter; yel. rocke	<i>Barbarea vulgaris</i>	—	—
— early	— <i>præcox</i>	—	—
Sea-stock, great	<i>Matthiola sinuata</i>	—	—
Rock-cress, fringed	<i>Arabis ciliata</i>	—	—
Wall-mustard, narrow-leaved	<i>Sinapis tenuifolia</i>	—	—
Sand-mustard	— <i>muralis</i>	—	—
Stork's-bill, hemlock	<i>Erodium cicutarium</i>	16.	2.
— sea	— <i>maritimum</i>	—	—
Crane's-bill, knotty	<i>Geranium nodosum</i>	—	5.
— stinking	— <i>robertianum</i>	—	—
— shining	— <i>lucidum</i>	—	—
— common dove's-foot	— <i>molle</i>	—	—
— small-flowered	— <i>pusillum</i>	—	—
— crimson-flowered	— <i>sanguineum</i>	—	—
Marsh-mallow, common	<i>Malva officinalis</i>	—	7
Mallow, common	— <i>sylvestris</i>	—	—
— dwarf	— <i>rotundifolia</i>	—	—
— musk	— <i>moschata</i>	—	—
Tree-mallow, sea	<i>Lavatera arborea</i>	—	—
Fumitory, common	<i>Fumaria officinalis</i>	17.	2.
— small-flowered	— <i>parviflora</i>	—	—
— ramping	— <i>capreolata</i>	—	—
Green-weed, Dyer's, or wood-waxen	<i>Genista tinctoria</i>	—	4.
Furze dwarf	<i>Ulex nanus</i>	—	—
Rest-harrow, common, or Cammock	<i>Ononis arvensis</i>	—	—
Ladies' finger, or kidney-vetch, com.	<i>Anthyllis vulneraria</i>	—	—
Vetchling, yellow	<i>Lathyrus aphaca</i>	—	—
— yellow meadow	— <i>pratensis</i>	—	—
— blue marsh	— <i>palustris</i>	—	—
Everlasting pea, narrow-leaved	— <i>sylvestris</i>	—	—
— broad-leaved	— <i>latifolius</i>	—	—
Vetch, wood	<i>Vicia sylvatica</i>	—	—
— tufted	— <i>cracca</i>	—	—
— rough-podded yellow	— <i>lutea</i>	—	—
— smooth-podded sea	— <i>lævigata</i>	—	—
— rough-podded purple	— <i>bithynica</i>	—	—
Tare, hairy	<i>Ervum hirsutum</i>	—	—
Horse-shoe-vetch, tufted	<i>Hippocrepia comosa</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Trefoil, white; Dutch clover	<i>Trifolium repens</i>	17.	4.
— honey-suckle, common clover	— <i>pratense</i>	—	—
— starry-headed	— <i>stellatum</i>	—	—
— hare's-foot	— <i>arvense</i>	—	—
— strawberry-headed	— <i>fragiferum</i>	—	—
Bird's-foot-trefoil, common	<i>Lotus corniculatus</i>	—	—
— greater	— <i>major</i>	—	—
Medick, black, or nonsuch	<i>Medicago lupulina</i>	—	—
St. John's-wort, large-flowered	<i>Hypericum calycinum</i>	18.	4.
— tutsan, or park-leaves	— <i>androsæmum</i>	—	—
— square; St. Peter's wort	<i>Hypericum quadrangulum</i>	—	—
— common perforated	— <i>perforatum</i>	—	—
— imperforate	— <i>dubium</i>	—	—
— marsh	— <i>elodes</i>	—	—
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COMPOUND.		COMPOSITE.	
Ox-tongue, hawkweed	<i>Picris hieracioides</i>	19.	1.
Row-thistle, blue	<i>Sonchus cæruleus</i>	—	—
— tall marsh	— <i>palustris</i>	—	—
— corn	— <i>arvensis</i>	—	—
— common	— <i>oleraceus</i>	—	—
Lettuce, strong-scented	<i>Lactuca virosa</i>	—	—
— prickly	— <i>scariola</i>	—	—
— least	— <i>saligna</i>	—	—
Hawkbit, deficient	<i>Apargia hirta</i>	—	—
— dandelion	— <i>taraxaci</i>	—	—
— autumnal	— <i>autumnalis</i>	—	—
Hawkweed, stained-leaved	<i>Hieracium maculatum</i>	—	—
— soft-leaved	— <i>molle</i>	—	—
— honey-wort leaved	— <i>cerinthoides</i>	—	—
— shaggy alpine	— <i>villosum</i>	—	—
— Hallerian dwarf	— <i>Halleri</i>	—	—
— shrubby broad-leaved	— <i>subaudum</i>	—	—
— small-toothed	— <i>denticulatum</i>	—	—
— rough-bordered	— <i>prenanthoides</i>	—	—
— narrow-leaved	— <i>umbellatum</i>	—	—
Hawk's-beard, small-flowered	<i>Crepis pulchra</i>	—	—
— smooth; smooth suc- } cory hawkweed	— <i>tectorum</i>	—	—
Cat's ear, smooth	<i>Hypochoëris glabra</i>	—	—
— long-rooted	— <i>radicata</i>	—	—
Succory, wild	<i>Cichorium intybus</i>	—	—
Burdock, common, or clot-bur	<i>Arctium lappa</i>	—	—
— woolly-headed	— <i>bardana</i>	—	—
Saw-wort, common	<i>Serratula tinctoria</i>	—	—
— alpine	— <i>alpina</i>	—	—
Thistle, musk	<i>Carduus nutans</i>	—	—
Plume-thistle, spear	<i>Cnicus lanceolatus</i>	—	—
— marsh	— <i>palustris</i>	—	—
— branching bog	— <i>Forsteri</i>	—	—
— woolly-headed	— <i>eriphorus</i>	—	—
— tuberous	— <i>tuberosus</i>	—	—
— melancholy	— <i>heterophyllus</i>	—	—
— dwarf	— <i>acaulis</i>	—	—
Cotton-thistle, common	<i>Onopordum acanthium</i>	—	—
Bur-marigold, three-lobed	<i>Bidens tripartita</i>	—	—
Hemp-agrimony, common	<i>Eupatorium cannabinum</i>	—	—
Goldyllocks, flax-leaved	<i>Chrysocoma linosyris</i>	—	—
Cotton-weed, sea	<i>Diotis maritima</i>	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Tansy, common	Tanacetum vulgare	19.	2.
Southernwood, field	Artemisia campestris	—	—
Wormwood, drooping sea	— maritima	—	—
— common	— absinthium	—	—
Mugwort	— vulgaris	—	—
— bluish, or Lavender-leaved	— caerulea	—	—
Cudweed, Jersey	Gnaphalium luteo-album	—	—
— American; pearly everlasting	— margaritaceum	—	—
— Highland	— sylvaticum	—	—
— upright wood	— rectum	—	—
— marsh	— uliginosum	—	—
— narrow-leaved	— gallicum	—	—
— common	— germanicum	—	—
Spikenard, plowman's	Conyza squarrosa	—	—
Flea-bane, Canada	Erigeron canadensis	—	—
— blue	— aceris	—	—
Groundsel, stinking	Senecio viscosus	—	—
Ragwort, inelegant	— squalidus	—	—
— hoary	— tenuifolius	—	—
— common	— jacobaea	—	—
— marsh	— aquaticus	—	—
— broad-leaved	— saracenicus	—	—
Star-wort, sea	Aster tripolium	—	—
Golden-rod, common	Solidago virgaurea	—	—
Elecampane	Inula helenium	—	—
Flea-bane, common	— dysenterica	—	—
— samphire-leaved	— crithmoides	—	—
Daisy, common	Bellis perennis	—	—
Ox-eye, yellow; corn marigold	Chrysanthemum segetum	—	—
Feverfew, corn; scentless Mayweed	Pyrethrum inodorum	—	—
— sea	— maritimum	—	—
Chamomile, common	Anthemis nobilis	—	—
— ox-eye	— tinctoria	—	—
Yarrow, sneeze-wort; Goose-tongue	Achillea Ptarmica	—	—
— serrated	— serrata	—	—
— common, or milfoil	— millefolium	—	—
— woolly, yellow milfoil	— tomentosa	—	—
Knapweed, brown radiant	Centaurea jacea	—	3.
— black	— nigra	—	—
Blue-bottle, corn	— cyanus	—	—
Knapweed, greater	— scabiosa	—	—
Star-thistle, Jersey	— isnardi	—	—
— common	— calcitrapa	—	—
— yellow; S. Barnaby's thist.	— solstitialis	—	—
<hr/>			
Ladies' traces, sweet	Neottia spiralis	20.	2.
Helleborine, broad-leaved	Epipactis latifolia	—	—
— marsh	— palustris	—	—
Birthwort, common	Aristolochia clematitis	—	3.
Spurge, purple	Euphorbia peplis	21.	1.
— petty	— peplus	—	—
— Portland	— Portlandica	—	—
— sea	— paralia	—	—
— sun; common wart-wort	— helioscopia	—	—
— upright warty	— stricta	—	—
Dur-reed, branched	Sparganium ramosum	—	2.
— unbranched upright	— simplex	—	—
Carex or sedge, curved	Carex incurva	—	—
— loose-spiked rock	— melichhoferi	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
or sedge, dense short-spiked	<i>Carex speirostachya</i>	21.	3.
— dwarf	— <i>capillaris</i>	—	—
sia, compound-headed	<i>Kobresia caricina</i>	—	—
, small	<i>Urtica urens</i>	—	4.
great	— <i>dioica</i>	—	—
ed, broad-leaved	<i>Xanthium strumarium</i>	—	5.
anth, wild	<i>Amaranthus blitum</i>	—	—
y, red-berried	<i>Bryonia dioica</i>	—	—
port, common	<i>Ceratophyllum demersum</i>	—	7.
-milfoil, spiked	<i>Myriophyllum spicatum</i>	—	—
-head, common	<i>Sagittaria sagittifolia</i>	—	—
w, long-leaved triandrous	<i>Salix triandra</i>	22.	2.
broad-leaved triandrous, or }	— <i>amygdalina</i>	—	—
almond willow }	— <i>Stuartiana</i>	—	—
small-leaved shaggy	<i>Mercurialis annua</i>	—	8.
ry, annual	<i>Atriplex portulacoides</i>	23.	1.
e, shrubby, or sea purslane	— <i>patula</i>	—	—
spreading halberd-leaved	— <i>angustifolia</i>	—	—
— narrow-leaved	— <i>erecta</i>	—	—
upright spear-leaved	— <i>littoralis</i>	—	—
grass-leaved	— <i>pedunculata</i>	—	—
stalked sea			

## SEPTEMBER.

d-glasswort, common; marsh }	<i>Salicornia herbacea</i>	1.	1.
samphire }	— <i>radicans</i>	—	—
— creeping	— <i>fruticosa</i>	—	—
— shrubby	<i>Zostera marina</i>	—	—
wrack, common	<i>Chara nidifica</i>	—	—
, proliferous	— <i>gracilis</i>	—	—
slender shining	<i>Callitriche autumnalis</i>	—	2.
-starwort, autumnal	<i>Veronica spicata</i>	2.	1.
well, spiked	— <i>agrestis</i>	—	—
— procumbent field	<i>Salvia verbenaca</i>	—	—
wild English	<i>Valeriana rubra</i>	3.	1.
an, red	<i>Crocus sativus</i>	—	—
n crocus	<i>Cyperus fuscus</i>	—	—
us, brown	<i>Scirpus holoschoenus</i>	—	—
ush, round cluster-headed			

<i>TRUE GRASSES.</i>	<i>GRAMINEÆ, N. S.</i>		
ail-grass, com. ; Timothy-grass	<i>Phleum pratense</i>	3.	2.
-grass, creeping sea	<i>Glyceria maritima</i>	—	—
ow-grass, flat-stalked	<i>Poa compressa</i>	—	—
— roughish	— <i>trivialis</i>	—	—
— annual	— <i>annua</i>	—	—
e-grass, smooth rye	<i>Bromus secalinus</i>	—	—
t-grass, creeping ; couch-grass	<i>Triticum repens</i>	—	—
l, small ; shepherd's staff	<i>Dipsacus pilosus</i>	4.	1.
us, devil's bit	<i>Scabiosa succisa</i>	—	—
in, sea	<i>Plantago maritima</i>	—	—
pellitory, common	<i>Parietaria officinalis</i>	—	—
' mantle, field ; parsley-piert	<i>Alchemilla arvensis</i>	—	—
weed, various-leaved	<i>Potamogeton heterophyllum</i>	—	3.
a, sea ; tassel pond-weed	<i>Ruppia maritima</i>	—	—
strife, wood ; yel. pimpernel	<i>Lysimachia nemorum</i>	5.	1.

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Lobelia acrid	Lobelia urens	5.	1.
Violet pansy ; heart's-case	Viola tricolor	—	—
— yellow-mountain	— lutea	—	—
Nightshade, common, or garden	Solanum nigrum	—	—
Centaur, dwarf-branched	Erythraea pulchella	—	—
Honeysuckle, common, or woodbine	Lonicera periclymenum	—	—
Goose-foot, upright	Chenopodium urbicum	—	2.
— many-spiked	— botryoides	—	—
— nettle-leaved	— murale	—	—
— fig-leaved	— ficifolium	—	—
Dodder, greater	Cuscuta Europaea	—	—
Gentian, marsh ; Calathian violet	Gentiana Pneumonanthe	—	—
— autumnal	— amarella	—	—
— field	— campestris	—	—
<hr/>			
UMBELLATE.		UMBELLIFERÆ, N. S.	
Shepherd's-needle, common ; Venus's } comb	Scandix pecten-veneris	5.	2.
Smallage parsley ; wild celery	Apium graveolens	—	—
Angelica, garden	Angelica Archangelica	—	—
Pepper-saxifrage, meadow	Cnidium silaus	—	—
Hare's-ear, slender	Bupleurum tenuissimum	—	—
Sulphur-wort, sea ; hog's fennel	Peucedanum officinale	—	—
<hr/>			
Grass of Parnassus, common	Parnassia palustris	5.	4.
Squill, autumnal	Scilla autumnalis	6.	1.
Meadow-saffron, common	Colchicum autumnale	—	3.
Evening-primrose, common	Oenothera biennis	8.	1.
Heath, fine-leaved	Erica cinerea	—	—
Persicaria, biting	Polygonum hydropiper	—	3.
— small-creeping	— minus	—	—
Knot-grass, common	— aviculare	—	—
Buck-wheat, climbing ; blk. bind-weed	— convolvulus	—	—
Strawberry-tree, common	Arbutus unedo	10.	1.
Saxifrage, yellow mountain	Saxifraga aizoides	—	—
Knawel, perennial	Scleranthus perennis	—	2.
Soap-wort, common	Saponaria officinalis	—	—
Pink, maiden	Dianthus deltoides	—	—
Campion, or catchfly, sea	Silene maritima	—	3.
Chickweed, common	Stellaria media	—	—
Sand-wort, fringed	Arenaria ciliata	—	—
Wood-sorrel, yellow procumbent	Oxalis corniculata	—	4.
Campion, white and red, $\beta$ . $\gamma$ .	Lychnis dioica	—	—
Mouse-ear Chickweed, narrow-leaved	Cerastium viscosum	10.	4.
Rose, Irish	Rosa hibernica	12.	3.
Strawberry, hautboy	Fragaria elatior	—	—
Pheasant's-eye, or Adonis-flower, corn	Adonis autumnalis	13.	5.
Crow-foot, lesser spear-wort	Ranunculus flammula	—	—
— pale hairy	— hirsutus	—	—
Vervain, common	Verbena officinalis	14.	1.
Mint, norse	Mentha sylvestris	—	—
— round-leaved	— rotundifolia	—	—
— pepper	— piperita	—	—
— bergamot	— citrata	—	—
— hairy	— hirsuta	—	—
— fragrant, sharp-leaved	— acutifolia	—	—
— tall-red	— rubra	—	—
— narrow-leaved	— gracilis	—	—
— corn	— arvensis	—	—

<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
rugged-field	<i>Mentha, agrestis</i>	14.	1.
penny-royal	— <i>pulegium</i>	—	—
nettle, or Archangel, white	<i>Lamium album</i>	—	—
-nettle, red	<i>Galeopsis ladanum</i>	—	—
d-wort, ambiguous	<i>Stachys ambigua</i>	—	—
— downy	— <i>germanica</i>	—	—
right, common	<i>Euphrasia officinalis</i>	—	2.
ragon, ivy-leaved	<i>Antirrhinum cymbalaria</i>	—	—
— broad-leaved, or fluellin	— <i>spurium</i>	—	—
— sharp-pointed fluellin	— <i>elatine</i>	—	—
flax, creeping pale blue	— <i>repens</i>	—	—
rape, branched	<i>Orobanche ramosa</i>	—	—
am, sweet	<i>Alyssum maritimum</i>	15.	1.
erd's purse, common	<i>Thlaspi bursa pastoris</i>	—	—
cross; swine's-cross, common	<i>Senebiera coronopus</i>	—	—
cket, purple	<i>Cakile maritima</i>	—	—
w-cross, creeping	<i>Nasturtium sylvestre</i>	—	—
— annual	— <i>terrestre</i>	—	—
o-mustard, fine-leaved	<i>Sisymbrium sophia</i>	—	—
er-cross, early	<i>Barbarea præcox</i>	—	—
mustard, narrow-leaved	<i>Sinapis tenuifolia</i>	—	—
mustard	— <i>muralis</i>	—	—
s-bill, hemlock	<i>Erodium cicutarium</i>	16.	2.
— sea	— <i>maritimum</i>	—	—
's-bill, stinking; herb Robert	<i>Geranium robertianum</i>	—	5.
— small-flowered	— <i>pusillum</i>	—	—
— crimson-flowered	— <i>sanguineum</i>	—	—
l-mallow, common	<i>Althæa officinalis</i>	—	7.
w, dwarf	<i>Malva rotundifolia</i>	—	—
mallow, sea	<i>Lavatera arborea</i>	—	—
ory, small-flowered	<i>Fumaria parviflora</i>	17.	2.
— ramping	— <i>capreolata</i>	—	—
-weed, hairy	<i>Genista pilosa</i>	—	4.
, dwarf	<i>Ulex nanus</i>	—	—
l, white; Dutch clover	<i>Trifolium repens</i>	—	—
om. purple; honey-suckle trefoil	— <i>pratense</i>	—	—
-foot, trefoil, common	<i>Lotus corniculatus</i>	—	—
hn's-wort, large flowered	<i>Hypericum calycinum</i>	18.	4.
— bearded	— <i>barbatum</i>	—	—
histle, common	<i>Sonchus oleraceus</i>	19.	1.
ce, strong-scented	<i>Lactuca virosa</i>	—	—
-weed, stained-leaved	<i>Hieracium maculatum</i>	—	—
— shrubby broad-leaved	— <i>sabaudum</i>	—	—
— narrow-leaved	— <i>umbellatum</i>	—	—
's-beard, small-flowered	<i>Crepis pulchra</i>	—	—
— smooth succory hawk- weed	— <i>tectorum</i>	—	—
e-thistle, spear	<i>Cnicus lanceolatus</i>	—	—
arigold, three-lobed	<i>Bidens tripartita</i>	—	—
— nodding	— <i>cernua</i>	—	—
locks, flax-leaved	<i>Chrysocoma linosyris</i>	—	—
n-weed, sea	<i>Diotis maritima</i>	—	—
wort, blueish, or lavender-leaved	<i>Artemisia cærulescens</i>	—	2.
ane, Canada	<i>Erigeron canadensis</i>	—	—
idsel, stinking	<i>Senecio viscosus</i>	—	—
— green-scaled	— <i>lividus</i>	—	—
vort, inelegant	— <i>squalidus</i>	—	—
vort, sea	<i>Aster tripolium</i>	—	—
n-rod, common	<i>Solidago virgaurea</i>	—	—



<i>English Names.</i>	<i>Latin Names.</i>	<i>Class.</i>	<i>Order.</i>
Ragwort, inelegant	<i>Senecio squalidus</i>	19.	2.
Daisy, common	<i>Bellis perennis</i>	—	—
Nettle, small	<i>Urtica urens</i>	21.	4.

## NOVEMBER.

Meadow-grass, annual	<i>Poa annua</i>	3.	2.
Chickweed, common	<i>Stellaria media</i>	10.	3.
Rose, Irish	<i>Rosa hibernica</i>	12.	3.
Snapdragon, ivy-leaved	<i>Antirrhinum cymbalaria</i>	14.	2.
Shepherd's-purse, common	<i>Thlaspi bursa-pastoris</i>	15.	1.
Furze, whin, or gorse, common	<i>Ulex Europæus</i>	17.	4.
Groundsel, common	<i>Senecio vulgaris</i>	19.	2.
Daisy, common	<i>Bellis perennis</i>	—	—

## DECEMBER.

If the weather be very open and mild.

Dead-nettle, Archangel, or white	<i>Lamium album</i>	14.	1.
— red	— <i>purpureum</i>	—	—
Furze, whin, or gorse, common	<i>Ulex Europæus</i>	17.	4.
Dandelion, common	<i>Leontodon taraxacum</i>	19.	1.
Groundsel, common	<i>Senecio vulgaris</i>	—	2.
Daisy, common <sup>a</sup>	<i>Bellis perennis</i>	—	—

<sup>a</sup> Occasionally some few others: none, however, are named by Dr. Smith.

## ERRATA.

- Page 4, line 15 from the bottom, *to* "separat," add "e."
- 17, — 5, insert "the" before "calculation."
- 24, left-hand page "42," reverse the figures.
- 29, the quotations are from DAVY'S *Agric. Lectures*.
- 31, line 6 from the bottom, after "o," insert "f," *read* "of which."
- 32, the heading line, *for* "MANURES, &c." *read* "GARDEN BEAN."
- 87, *for* number "2," *read* "92."
- 90, *for* number "85," *read* "95."
- 95, line 17, *for* "that base," *read* "gas."
- 103, — 22, between "be question," insert "no."
- 112, fifth sort in the list of cabbages, *read* "Vanack."
- 122, line 7, *for* "Botrytes," *read* "Botrytis."
- 168, — 19, *for* "*lusinea*," *read*, "*lucinea*."
- 187, line 21, "developmeent," *read* "developement."
- 202, — 14 from the bottom, *for* "Grenfil," *read* "Grenfell."
- 212, — 5, *for* "206," *read* "209."
- 213, last line and word, *for* "foresight," *read* "foreright."
- 215, line 8 from the bottom, *for* "219," *read* "220."
- 237, — 9 from the bottom, *for* "pearl," *read* "pear."
- 257, last word of No. 264, "reed" should be "seed."
- in the note, the numbers should be "Fig. 17—2, par. 385."
- 262, line 13, *for* "rowed," *read* "rooted cuttings."
- 297, first line of the note, *for* "cause," *read* "course."
- 301, note, *for* "242," *read* "243."
- 346, line 5 from the bottom, and again in note, *for* "Sausure," *read* "Saussure."
- 376, line 4 from the bottom, *for* "annuual," *read* "annual."
- 384, — 26, first word, insert "l," and *read* "limb."
- 386, — 4 above the notes, *for* "sulphurate," *read* "sulphuret."
- 392, — 10 from the bottom, *for* "246," *read* "247."
- 401, in par. 448, *read for* "13, 14, 15," "10, 11, and 12."
- 423, alter the number to "248, i."
- 443, line 6, *for* "an" *read* "and."
- 456, — 17, *for* "plants," *read* "plots."
- 459, — 3 from the bottom, *for* "flavoured," *read* "flavour."
- 507, — 24 *for* "lychins," *read* "lychnis."
- 534, — 16, insert "a," before the words "bearing-spur."
- 576, heading line, *for* "RHUBARB," *read* "HORSE-RADISH."
- 614, line 25, *for* "pine-slip," *read* "pine-pit."

# INDEX.

The letter (p) before the figures indicates the page. In all other cases the figures refer to the numbered paragraphs.

- ABERCROMBIE**, John, method of trenching, 453  
 — Note, p. 399  
**Acacia**, pseudo, or locust, 555; 646  
**Aikin**, Dr., on buds and roots, 525  
**Alkaline salts** in plants, p. 2  
**Alkaloid**, a vegetable principle, p. 3  
 — *Morphia*, *Quinia*, *Cinchonia*, *Lupuline*, *Emetine*, pp. 3, 4  
**Almond-tree**, *Amygdalus communis*, varieties and culture, 128  
**Alumine**, *Alumina*, contrasted with *silex*, 5  
**Ammonia**, (azote and hydrogen,) 100  
 — developed, Note, p. 105  
**Analysis of soils**, pp. 13—25  
 — apparatus, pp. 13, 14  
 — chemical tests, pp. 14, 15  
 — mechanical processes, p. 15 (*a b c*)  
 — *chemical*, p. 16  
 — for *carbonate* of lime (chalk) by *muratic acid*, p. 16 (*d*)  
 — *iron*, by *prussiate* of potassa, p. 17 (*e*), p. 21 (*k*)  
 — by fire, vegetable substances, p. 20 (*h*)  
 — *alumine*, by *sulphuric acid*, p. 20 (*i*)  
 — — to precipitate by ammonia and soda, p. 22 (*l*)  
 — *saline substances*, p. 23 (*m*)  
 — products of, p. 24  
 — *gypsum*, by a separate process, p. 24  
**Aphis**, or green fly, 429  
**Apium**, celery and parsley, 354, 575  
**Apple-tree**, botanical character and history, 37  
 — propagated by seeds, cuttings, and grafting, 38  
 — espaliers, 39; 725  
 — bearing, pruning, 40  
 — soil and situation, 41  
 — choice of sorts, 42  
**Apricot-tree**, botanical character, history, and varieties, 161  
 — propagation by budding, 162  
**Apricot-tree**, planting and training, 163  
 — pruning, 164, 165, 166  
 — thinning of the fruit, 167  
 — diseases, blight, 168  
**April**, operations of, 160, 169  
 — plants in flower, 171  
**Artichoke**, *Cynara Scolymus*, botanical character and varieties, 406—7  
 — propagation, culture, by M'Phael and Abercrombie, 408  
 — winter dressing, 410; spring ditto, 411  
 — duration, 412; seeding, 413  
**Ash-tree**, *Fraxinus excelsior*, 645  
**Ashes** for walks, and as manure, 449, 514  
 — vegetable ashes, p. 2; 103 (*b*), p. 106  
**Asparagus**, *Asparagus officinalis*, botanical character and history, 148  
 — propagation, 149  
 — soil and preparation, Judd's method, French method, M'Phael's, 150  
 — planting, 151; Grayson's Giant asparagus, 151  
 — general culture and remarks, 153—156  
 — duration of the beds, 158  
 — saving the seed, 159  
**ATMOSPHERE**, section on, p. 130—147;  
 elasticity of aëriform fluids, 132;  
 chemical properties of air, 133;  
 azotic gas, 134; evaporation from the earth's surface, 135; vapour and steam, 136; atmospheric vapours, 137; chemical union of, 138; compressibility of air, 139; pressure, 140; atmospheric theory, 141; modification of clouds, Luke Howard's, 144—148  
**Attraction and repulsion**, laws of, 102  
**August**, operations of, 423—439  
 — plants in flower, 441  
**Azote**, or *nitrogen*. See Note, p. 105  
 — nature of, 134

- Bark, inner, or *liber*, formation of, 404
- Barometer, atmospheric pressure, 140
- Bean, garden, *Vicia faba*, character and history, 20; varieties, 21
- cultivation, 22
- crops, main, and successional, 23
- Beet-root, *Beta vulgaris*, botanical character, 71; varieties, 72; culture, 73; saving seed, 74
- Bedding, in sowing, 645
- Bilberry, or whortleberry, 555 (5)
- Borecole, *Brassica sabellica*, 118
- varieties, German kale, 118
- ——— Woburn kale, 119
- Brassica, the cabbage tribe, 108—125
- Box-edgings, 50; to plant, 515
- Broccoli, *Brassica botrytis*, introduction, 122
- varieties, autumnal, 123
- general culture of spring varieties, 124
- saving seed, 125
- Brussels sprouts, *Br. oler. bullata gemmifera*, 117
- culture, Cobbett's remarks, 117
- Botanical criterion of earths, p. 2
- Budding, science of, Du Hamel's decisive experiment, 706
- success, criterion of, 707
- season, and choice of buds, 708
- varieties, T budding, 710
- scalope, 712; shield, 713
- remarks, 711; future treatment, 714
- Buds, origin of, 707; electrical agents of conduction, letter of T. P., p. 311
- Bulb, definition of, 244 (7)
- Bulbous roots, flowering, 91, 130, 171, 239, 296, 379, 440, 501
- Cabbage, common, *brassica oleracea*, botanical character, 108
- varieties, 109
- spring sowing, 110
- main crops, for summer, 111
- soil, situation, 112
- seed, 113
- *Coleworts*, 114.
- the red, *brassica oleracea rubra*, culture, 115
- Cambium, or proper juice, 402
- Carrot, *Daucus carota*, botanical character, 75
- varieties, 76
- culture and soil, 77
- Caterpillar, gooseberry, 247, 438
- Cauliflower, *Bras. oler. cauliflora*.
- propagation and culture, 120
- spring sowings, and seed, 121
- Celery, *Apium graveolens*, botanical character of wild celery, 354
- sweet, its varieties and uses, 354
- propagation, 356
- culture by Abercrombie, 357—361
- by Judd, sowing, 362
- transplanting, 363
- future culture, 364
- general remarks, 365
- protection, 366
- Celeriac, solid, or turnip-rooted celery, Abercrombie and Sabine's directions, 367
- seed, 368
- Chalk, carbonate of lime, p. 16 (d), retains water, 6, 450
- its value in a garden, 450
- Chemical and electrical action and affinity, identical, 102 (c), 201
- Cherry-tree, *Cerasus*, history of, 272
- varieties, 273
- propagation, 274
- soil and situation, 275
- pruning and training, 276, 277
- Morello, 278
- Underwood's remarks, 279
- Chives, *Allium schænoprasum*, culture, 662
- Cider, cider apples, 547
- Clay, for grafting, substitutes for, 699
- Clouds, Howard's classification, 143; *cirrus* 144; *cumulus* (2), *stratus* (3), *cirro-cumulus*, (4) 145; *cirro-stratus* (5), *cumulo-stratus*, 146, (6); *cumulo*, *cirro*, *stratus*, or *nimbus* (7), transitions of forms, 147
- Cochlearia armoracia*, horse-radish, 737—741
- Corn salad, *Fedia olitoria*, 570—571
- Cranberry, *Oryzococcus palustris*, botanical character, 594
- American, 595
- cultivation, 596
- culture in dry beds, 597
- Oldacre's observations, 597
- Cress, garden, *Lepidium sativum*, culture of, 566
- Crops of the main garden, 537—8
- rotation of, 539
- Cucumber, *Cucumis sativa*, Appendix, p. 608
- culture in frames, without heat, pp. 608—9
- Nicol and M'Phael's remarks on stopping, 609
- planting out, stopping, 610, 611
- forcing, with a plan of Patrick's brick-pits, 612
- culture in the stove, in pots, 614
- Currant, *Ribes*, botanical character, 424

- Currant**, species, red and white, varieties of, 425  
 — propagation, 426  
 — by seeds (1), cuttings (2), suckers (3), methods of pruning, 427; long pruning (1), spur pruning (2), summer pruning (3).  
 — Insects, &c., 429; care of fruit, 430  
 — the black currant, 431—2  
**Cuttings**, propagation by, 626  
 — preparation, 628  
 — ringing, 629  
 — of pinks, pipings, 631
- Darwin**, Dr., theory of electricity, 53  
 — on the descent of the sap, 402
- Davy**, Sir Humphry, on electricity, 53  
 — electro-chemical attraction, 102  
 — remarks on grafting, 693
- December**, operations of, 746, 764
- Dew**, phenomena of; radiation of, 193  
 — Clouds reflect heat, 194  
 — Causes of Dr. Wells' theory, 195; experiments, 196  
 — snow covering, protection by, 197  
 — remarks on radiation, 197  
 — influence of trees, 198  
 — deductions from facts, 199  
 — a phenomenon of induction, 200—1
- Diamond**, pure carbon, p. 4
- Digging beds**, best method, 110, p. 114
- Drills**, drill sowing, 614
- Du-Hamel**, theory of the sap, and experiments, 402, 706  
 — note, p. 304
- Dung**, recent, as manure, 16, 17, 459
- Dutrochet**, electrical theory, 54, 395—8
- Dwarf standards**, 543  
 — orchard of, 546  
 — cider apples, 546
- Earths**, native, decomposing power, 450  
 — soils, manures, Section on, p. 7 to 31  
 — classification, 1  
 — qualities and value of, 2  
 — uses of, 3  
 — tenacity and coherence, 4  
 — friability, 5  
 — absorbent powers, 6  
 — *subsoil*, productiveness, 6  
 — chemical agency of soils, 7  
 — pulverization, depth of, 8  
 — aëration, and exposure, 9  
 — improved by changing ingredients, by burning, by addition, 10  
 — ANALYSIS, p. 13. *See* A.  
 — manures and composts, Part II.  
 — — vegetable and animal matters, 12—13
- Earths**; manures, fermentation of, 15  
 — — injurious when extreme, 16  
 — — mineral; quick-lime, gypsum, common salt, 18  
 — — conclusions deduced, 19
- Elder-tree**, *Sambucus nigra*, raised from seed, 560
- ELECTRICITY**, Section on, pp. 54—71  
 — of nature, 52  
 — agency in vegetation, 53  
 — theories of, vague, 53—4  
 — source of, 55  
 — nature of the sun; Newton, Boerhaave, De Luc, Dr. Herschel, 56—7  
 — composition of the sun's rays, 58  
 — Ethereal fire of the ancients, 59  
 — properties of the rays, 60  
 — electrizing principle, 61  
 — sun's influence upon vegetables, 62, 63  
 — *Electrical theory*, magnetism, 66  
 — *Electrical laws*, *Induction*, 68  
 — gravitation considered, 69
- Elements of plants**, p. 2
- Endive**, *Chicorem endivia*, or *Cichorem*, character; varieties, 487  
 — propagation, sowing, 488  
 — transplanting, 489  
 — blanching, 490  
 — saving seed, 491
- English Botanist's Companion**, p. 629  
 — General classification, Linnæan system of classes and orders, 629, 630  
 — monthly catalogue of plants, 631, to the end
- Epidermis**, vegetable cuticle, 243, 321
- Espalier for grapes**, 542  
 — orchard, 544  
 — rails, 759  
 — training, 39, 719
- Evergreen oak**, *Quercus ilex*, 555, 647
- Exosmose and endosmose of Dutrochet**, 395—8
- Exudation**, radical, of plants, 409. *See* Raspberry.
- Fan-training**, 726
- Farina**, or pollen, structure, agency, 601—3
- February**, operations of, 82—89
- Fedia**, corn-salad, 570—1
- Fence**, wooden paling, 541  
 — trellis for, fig. 28.
- Ferro-cyanide of potassium**, test for iron, p. 17 (*c.*)
- Fibrous roots**, origin, 525  
 — system of plants, 316, note

- Fig-tree, *Ficus carica*;** botanical character and history, 280
- varieties, 281
  - propagation, 282
  - soil, 283
  - situation, 284
  - dwarf, 285
  - pruning, 286
  - mode of bearing, 287
  - Wickham's treatment, 289
  - Swaine's, 290
  - protection, woollen nets, 292
  - forcing, 293, p. 275
- Fir-tree, *Pinus abies*,** 551
- Flower-borders,** 50, 130, 440
- Flowers and shrubs, monthly selection of,** for February, 91; March, 129; April, 171; May, 239; June, 295; July, 380; August, 441; September, 502; October, 599
- Forest-trees, screen, or plantation of,** 549, 561
- Fragaria.*** See Strawberry, 580
- Fruit department.—Operations of** January, 49; February, 89; March, 129; April, 169; May, 237; June, 294; July, 378; August, 439; September, 500; October, 598; November, 680; December, 764
- Functions of the vegetable organs.** See Vegetable Physiology, Part III., p. 299
- Garden, construction of, I., pp. 395—422**
- Part I. Object and importance of, p. 395
  - Part II. Situation, 442—3; exposure and aspect, authorities, 444—5; the soil, 446; loam, 447; comparison of facts, 448; depth of the soil, 449; chalk, its qualities, 450
  - Part III. Preparation of the ground by trenching, plan, 451—2; Abercrombie's ridge-trenching, 453; Cobbett's, 455; depth of, 459; draining, remarks, 457—8; importance of trenching, to the growth of timber, 460
  - Planting,—Sir Henry Stuart's rules, p. 410; No. 1—6)
  - Part IV. Protection and shelter, by brick walls, &c., 463; solid walls, 464; cellular wall, 465; Construction: built on arches, 466; materials, 467; copings, 468; Slips, or outer garden and enclosure, 470—1; of the orchard; ring-fence, 472; quick-set hedge, and directions for raising, 473—6; holly-hedge, 477
- Garden, construction of, S. II., p. 439—474**
- extent of the garden, 504—5
  - plan, 506
  - Part II. Laying out the area, order of the work, 507; preparation of the fruit-borders, 508—9; remarks, depth of soil, 510; preparation of the walks, materials, &c., 511—12; particular directions, 513; minor walks, 514
  - preparations of the box-edgings, 515—16
  - reservoir of water, 518; manure and compost ground, 519
  - Part III. Selection of wall fruit-trees, 521—2; age of the trees, 523; attention to the roots, 524; pruning the roots, 525; adaptation of the trees, 526; to the north wall of the main garden, 527; to the east and west walls, 529—31; to the south wall, 532; to the outer surfaces of the walls, 533—5; wall of the espalier orchard, 536
  - permanent vegetable crops, 537; temporary crops, 538; rotation, 539; planting the slips, 540; the fence, or paling, 541; espalier for grapes, 542; claret vines and wine, 542
  - Part IV. Arrangement of the orchards, and screen of forest-trees; dwarfs and espaliers, 543; espalier orchard, 544; apples, (1), pear-trees (2), cherry-trees (3), plum-trees (4); cultivation of the soil between espaliers, 545; planting the west orchard; trees, 545—6; manufacture of cider, cider apples, 547; pears, morello cherries, mulberries, 548; screen of forest-trees, order of the work, 551; method of planting, 552; spruce firs; table to estimate the number of trees, 554; selection of the trees, 555; maxims and directions for planting, 556; heading down, 557; pruning, 558; final arrangement and plan, 559
- Gardening, scientific operations, first section of,** p. 491—517; propagation by seed, 600—2; agency of the pollen, 603; theories of the ovarist (1), of the animalculist,

- (2), of the epigenesist (3); electrical theory, 604; Knight's experiment with peas, 605; with the apple-tree, 606; maturity and durability of seed, 607—8; period of germination, table, 612; formation of seed-beds, 613; drill-culture, and plan, 614;
- Gardening ii. Propagation by runners, 615; suckers, 616; layers, 617; by slips, 625; cuttings, 626; pipings, 631
- Part II. Preparations for grafting.—Raising stocks for apples, 633—637; for pears, 638; for apricots, 641, 642; for plums, 643; for cherries, 644
- Part III. Propagation of forest-trees.—The ash, 645; the locust, or pseudo-acacia, 646; the evergreen oak and live oak, 647
- Scientific operations, second section of, p. 539—574
- Part I. Operations of *grafting* and *budding*.—Origin, 682; object of, 683; theory of, 684; varieties of, 687; whip or tongue grafting, 688, 689; mode of operation, 690; cleft-grafting, 691; crown grafting, 692; saddle-grafting, 694; root-grafting, 695; preparation of the scions, 696; future treatment of grafts, 697; choice of stocks, 698; grafting-clay, 699; inarching described, 700—701; Knight's experiment on a peach, 702; *budding*, 705; science of, Du Hamel's experiment, 706; preparation of buds, 707; season of budding, 708; *varieties*, T-budding, 710; scallop-budding, 712; shield-budding proper, *L'écusson*, 713; future treatment, 714
- Part II. Pruning and training.—Object of pruning, 716; to form standard trees, 717; dwarfs, 718; horizontal training, 719; Harrison's course during ten years, 720—725; Fan-training of the peach as practised by Mozard of Montreuil during a course of six years, 727—732
- Part III. Operation to produce fruitfulness.—Renewal of the soil, 733; pruning of roots, 734; ringing, 735
- Garlic, *Allium sativum*, culture of, 663, 664
- Gooseberry-tree, *Ribes grossularia*, varieties, 434
- Gooseberry-tree, propagation and culture, 435
- Harrison's directions, 436
- winter treatment, 437
- insects, 438
- Gossamer, remarkable case of, 490
- Grafting, defined, 681, 682
- by approach, 700—1
- cleft or head, 691
- crown or rind, 692
- root, 695
- saddle, 694
- tongue or whip, 688
- Grape-vine, botanical character and history of, 669, 670
- vineyard at Pain's Hill, 670
- varieties and catalogue, 671
- propagation, 672; by seed, 673; cuttings, 675; layers, 676
- inarching, operation described, 678, 679
- Harrison's method of long pruning for the open wall, 748—756
- vine border, 748
- planting, 749
- first year's pruning, 750; second year, 751; third year, 753; fourth year, 754; fifth year, 755; sixth year, 756
- fan or fruit-tree method, 757
- espalier training, 758; erection of an espalier, 759; planting and training, 760; first year, 761; second year, 762; third year and subsequent winter pruning 763
- Grapes, selection of, 535, 671
- claret-wine, 542
- Gravel walks, 512
- particular directions, 513
- Gravitation, 69
- Hamburgh parsley cultivation, 578
- Hamilton, Hon. Charles, vineyard, 670
- Harrison, Charles, Treatise on fruit-trees, his method of horizontal training, 224, 719
- on the strawberry, 583, 592
- on the vine, 748
- Hautboy strawberry, 580, 589
- male blossoms, 589
- Heat, Sect. I. May, Part II. pp. 182—197
- nature of, 186—189
- caloric, 189
- Black, Dr., theory of latent heat, 190; experiments, (1—3)
- Ice, temperature of, 191
- radiation, dew, 193
- phenomena, (*See Dew*,) 194—201



- Magnetizing power of the rays of light, 179
- Main, James, theory of the vital membrane, or *indusium*, 402, 700
- Manures and composts, vegetable and animal, 12, 13
- fermentation, 15
  - wherein injurious, 16
  - mineral, lime, gypsum, salt, 18
  - general conclusion, 19
- March, operations of, 126, 129
- Matter of fire, *caloric*, 56, 189
- Maturity of seeds essential, 607
- May, operations of, 216, 237
- Medlar-tree, *Mespilus Germanica*, botanical character and varieties, 48
- Medullary rays, convergent processes, 313
- origin of, 328—330
- Miscellaneous operations, 50, 90, 130, 170, 238, 295, 379, 440, 501, 599, 680, 765
- Molecules, active, 303
- Moon's rays, De la Hire's experiment, 192
- Morello-cherry, pruning, 278
- Mulberry-tree, *Morus nigra*, botanical character and history, 370
- propagated by layers, 372; cuttings, 373; by grafting, 374
  - situation, 375
  - mode of bearing, pruning, 376
  - wall and espalier training, 377
- Mustard, *Sinapis*, white, 563
- black, 564
- Nasturtium, or Indian cress, 572
- Natural electricity defined, 101
- Naturalist's calendar of January, p. 52; February, 85; March, 128; April, 168; May, 225; June, 278; July, 337; August, 394; September, 438; October, 490; November, 538; December, 589
- Nectarine, *Persica laevis*, 127. See Peach
- New Zealand spinach, *Tetragonia expansa*, description and treatment, 421
- Anderson's mode of culture, 422
- Nitrous acid, in vegetable anatomy, 300—302
- Norway, or spruce fir, *Pinus abies*, 551
- November, operations of, 668, 680
- Oak evergreen, *Quercus ilex*, 647
- live, *Quercus phellos virens*, 555, 647
- October, operations of, 579, 598
- Onion, *Allium cepa*, botanical character, 648
- varieties, 649
  - soil, 651
- Onion, culture by Abercrombie, 652
- on drill-culture, 653
  - Knight's two-year's culture by small bulbs, 654, 655
  - summer crops, 655
  - taking the crop, 656
  - saving seed, 657
  - potato-onions, 658
- Orchard of espalier trees, planting, 544
- cultivations between the trees, 545
  - west planting, 546
- Oxygen, nature of, identity with silic, 101; produced by light, 181, 182; by decomposition of water, 95
- Parsley, garden, *Apium petroselinum*, 575
- varieties, 576
  - culture, 577
  - Hamburgh, 578
- Parsnep, *Pastinaca sativa*, botanical character, 78
- culture, 78
  - culture in strong ground, 80
  - wine, Note, 81
- Pea, *Pisum sativum*, varieties, 24
- early crops, how raised, 25
  - succession, 26
  - late crops, 27
  - culture, 28
  - soil, 29
- Peach-tree, *Persica vulgaris*, botanical character and history, 83
- propagation and culture, 84
  - pruning, axioms of, 85
  - protecting the fruit, 86
  - varieties, 88
  - acceleration in glazed pits, p. 83
  - French method of training, 727
- Pear-tree, *Pyrus communis*, 43, 44
- pruning standard trees, by Knight, 45
  - setting the fruit, 46
  - selection, 46
  - stocks for, 639—640
- Persian melon, Appendix, pp. 616—622
- botanical character, 611
  - 1. striped Housainee of Knight, or green Housainee, 616
  - 2. white-fleshed Housainees; habits of the Persian, 617
  - amphibious character—roots in water, 618
  - Knight's melon-house, 619, 620
  - culture in pots—in brick-lined pits, 621
  - propagation by cuttings, 622
- Pine-apple. See Appendix, p. 622, 628
- *Ananassa sativa*, botanical character and varieties — black

- Jamaica, St. Vincent or green olive, queen-pine, p. 623
- Pine-apple, propagation and culture by Greenshields' suckers, 624
- succession-plants, 625
- fruiting plants, 626
- culture in pits with linings, 628
- Pipings of pinks, 631
- Planting trees, select or discriminate, 544
- Sir Henry Steuart's rules for, 460
- Plum, Coc's golden drop, 218
- Plum-tree, *Prunus domestica*, history of, 217
- varieties, selection, 218
- propagation and culture, 219
- training and pruning, 220, 221
- Harrison's horizontal training, an eleven years' course, 224—236
- soil and aspect, 222
- diseases, 223
- Pollen, or *farina*, agency of, 602, 603
- theories of the ovarist (1); animalculist (2); epigenesist (3)
- electrical theory, 604
- said to contain *hydrogen*, p. 242
- Pores of the leaves, 335, 336
- Potassa, carbonate, test for chalk, p. 19, (g)
- pure or caustic, p. 14
- prussiate, or *ferro cyanate of potash*, preparation, p. 17 (e)
- Potatoe, *Solanum tuberosum*, history of, introduction, 202
- uses, 203
- analysis, 204
- used in bread—salubrity, 205
- varieties, 206
- propagation, 207
- season, and methods of planting, 208
- Knight's culture, 209
- comparative experiments and products, (1837, 1838,) 209
- early potatoes, 210
- winter crop, 210
- subsequent culture, 211
- taking the crop, 212
- preservation, 213
- Propagation by cuttings and slips, 615 ; by layers, 617 ; suckers, 616
- Pruning, its object, 716
- to form standard-trees, 717
- to form dwarf-standards, 718
- Quercus Ilcx*, *phellos*, 647
- Quince-tree, *Pyrus cydonia*, botanical character and varieties, 47
- Radish, *Rhaphanus*, botanical character, and description, 349
- Radish, varieties, preference, 350
- culture of the spindle and round-rooted, 351
- large turnip, 352
- saving seed, pods, 353
- Rain, atmospheric vapours, 137
- Rape, *Brassica napus*, 343. See Turnip
- Raspberry, *Rubus idæus*, botanical character and natural history, 493
- varieties, 494
- propagation, 495
- situation, 496
- M'Phael's directions, Harrison's, 497, 498
- duration, remark connected with rotation of crops and fecal exudation, 499
- Red-beet, *Beta vulgaris*, 71—74
- Reducent vessels of the bark, 405
- Rhubarb, *Rheum*, botanical character and varieties, 742, 743
- sub-varieties, dwarfs, 743 (5)
- propagation and culture, 744
- gathering and blanching, 745
- Ridging, ridge-trenching, 453—454
- Ring for production (1), maturation (2), 735
- Roots, pruning, 524, 525, 734
- Runners, propagation by, 615
- Salad, grown on flannel, and metallic oxides, 568
- Salt, as manure, 18
- for orchards, 547
- Sap, theories of the ascent, 386—399
- vessels, 310, 11
- Savoy cabbage.—See *Brassica*.—propagation and culture, 116
- Screen of forest trees, selection of, 550
- planting, 555
- final arrangement, 559
- Scions, or grafts, indiscriminate, will not succeed, 686
- preparation of, and remarks, 696
- Sea-kale, *Crambe maritima*, botanical character and history, 256
- soil and propagation, 257
- culture, 258
- blanching, 259
- forcing, 260 ; Baldwin's and Barton's method, 261
- Seed-bed, and drilling, 614
- Seeds, experiments with, in hot water, 646
- quality of, 600
- maturity and durability, 607, 608
- periods of germination, 612
- Shallot, or eschalot.—See *Allium*, 665
- cultivation of, 666
- Sinapis, Mustard, see 562—4

- Slips, outer garden, planting and cropping, 540
- Slug, *Limax*, to destroy, 481
- Soda, in plants, p. 2  
— compared with salt, 18
- Soils, earths, ANALYSIS of, pp. 13—25
- Solar rays, refrangibility and heating power, 192  
— magnetizing power, 179  
— maturing power, 63
- Spectrum, prismatic, of Newton, 176
- Speechley, William, *Treatise on the Vine* referred to, pp. 532, 3
- Spinach, spinage, *Spinacia oleracea*, botanical character, 414  
— summer, or round-leaved, 416  
— culture, 417—18  
— winter spinach, or prickly-seeded, 419
- Spiral vessels, in asparagus, 310  
— act as springs, 332
- Stocks, preparation of, for grafting and budding, 633  
— for apple-trees, 633—7  
— apricots, 641  
— cherries, 644  
— peaches and nectarines, 640  
— plums, 643
- Strawberry, *Fragaria*, botanical character and varieties, 580  
— propagation, 582  
— Keen's directions, 584—9  
— prepared for forcing, 591  
— Keen's seedling, 591  
— in pots, forcing, Appendix, pp. 606—8  
— time and manner, temperature and water, 607  
— winter treatment of plants, 608
- Suckers, propagation by, 616
- Sun, the great *first principle*, constitution of; theories, 56—58  
— influence of, upon animals, 64—5
- Sun-flower, *Helianthus*, 545
- Table to estimate the number of trees in planting, 554
- Tanks for rain-water, 518
- Theory—of the atmosphere, 141; of the dew, 199; electrical, 66; of light, 185; of the ascent of the sap, 399
- Training, espalier, or horizontal, by Harrison, 719—724  
— general remarks, 725
- Trenching, directions, 451—457
- Transplanting, cautions on, 526
- Trees, heading down, 557  
— pruning, 558
- Tubes, conduits of the sap, 307, by Mirbel; porous (a), spiral (b), false spiral (c), mixed (d), small tubes (e), simple tubes (f)
- Turnip, *Brassica napus*, specific character (*see* Brassica) 338; varieties, 339; Swedish turnip, 340; soil and situation, 341; culture of the common turnip, 342; of the navet, 343; of the Swede, 344; the fly or beetle, *Haltica*, 345; taking the crops, 346; seed, 348; turnip-tops, 347
- Van Mons, Dr., remarks on seedling apples and pears, 639
- Vapour and steam. *See* Water, 136
- Vegetable department, operations of, for January, 36; February, 82; March, 126; April, 160; May, 216; June, 271; July, 369; August, 423; September, 492; October, 579; November, 668; December, 746.
- VEGETABLE PHYSIOLOGY, first section on, pp. 226—248; external organs of plants, 240; branch and appendages, 244—6; calyx and varieties, 250; corolla and parts, 251; flower, 249; inflorescence, 248; receptacle, 255; root, 242; seeds, *Semina*, and parts, 254; embryo (1), cotyledons (2), Albumen (3), vitellus (4), testa (5), hilum (6); seed-vessels, 253  
— second section on, pp. 279—314; internal structure of plants, cellular tissue, 309; conducting vessels, 310—314; dissection, instruments of, 298; of observation, 299; elementary components, 304; reducent vessels, 317; situation of the vessels and cells, 312; vascular system, 307; vessels of the root and stem, 308; vessels now called ducts, 311; vessels of the stem, 313, and of the leaves, 314—316. *Functions of the organs*—of the cellular membrane, 323—325; the conducting and spiral vessels, 330—332; epidermis, 321, 322; leaves, 333—336; medullary rays, 326—329; root, 318—320. Vegetation and electricity, relation between (letter of T. P.), 337  
— third section on, pp. 339—370; nature of vegetable life, 381; progress of vegetation, 382; chemical phenomena of germi-

- nation, 383; agency of oxygen, 384; ascent of the sap, 386; theories of Malpighi and Grew, 387; of Mr. Knight, central tubes, 388; channels of, 389; causes of the ascent, 390; theories, 391; agency of heat, 392; of irritability, 393; of contraction and dilatation, 394; Dutrochet's electrical theory, 395. *Electrical theory*, 399; process of vegetable nutrition, 400; Knight's theory of the progress of the sap, 401; descent of the proper juice, 402; origin of the liber and alburnum; experiments of Dr. Hope and Du Hamel, 404
- VINE**, *Vitis vinifera*, botanical character and history of the vine, 669, 670
- varieties and catalogue, 671
  - propagation, 672—676
  - inarching and grafting, 678, 679
  - soil and planting, 748
  - long-pruning of Harrison—winter pruning of 1st year, 750; 2nd year, 751; 3rd year, 753; 4th year, 754; 5th year, 755; 6th year, 756
  - fan or fruit-tree training, 757
  - espalier training, 758—763, with figures
  - border preparation, 748
- VINERY**, Appendix, pp. 592—606
- building and materials, outlay, dimensions, 593—595
  - flue, 594, 595
  - furnace, 596
  - forcing, objects of, 598
  - Grape-vines, three varieties, 599
  - border for, 597
  - planting, culture, and distribution of the trees, 599—601
  - Seton's horizontal training, 601, 602
  - Stafford of Willersley, on the culture of vines in pots, 603
  - soil, preparation of the plants, 603, 604
  - water, double pots, 605, 606
- VINERY**, winter protection—effects of the frost of January, 1838, 605
- Vineyard, 670
- Vital principle, p. 5
- Voltaic electricity, troughs, 95
- Walks, materials, 511
- particular directions, 513
- Walls, solid, 463, 464
- cellular, 465
  - advantage of the latter in the vinery, and other forcing houses, p. 593
- Wall-fruit, selection of, 522
- trees for east wall, 529, 530
  - — north wall, 534
  - — south wall, 532
  - — west wall, 529, 530
- WATER**, Section on, pp. 87—111
- nature of, 92, 93
  - its constituents, 94
  - decomposition by voltaic electricity, 95; voltaic troughs improved by Dr. Faraday, his researches referred to, 95
  - reproduced, 96
  - Part II. Of *hydrogen*, its base traced to water, 99
  - ammonia electrolytically decomposed, 100
  - *oxygen*, identity with silex, Mr. Hume's paper, 101; an electrized element of water, 101
  - laws of chemical attraction and repulsion, 102
  - Part III. Decomposition by the natural agents, 103; by solar power (*a*); by subterraneous agents (*b*); by vegetable, vital action (*c*),
    - general properties of, 105
    - ice and snow, 105
    - in the fluid state, 106
    - as vapour, 107
- Water in a garden, importance of, 517
- Water-tanks, 518
- Wine from unripe grapes, 542; parsneps, p. 76
- Zea Mays*, Indian corn, p. 264—271

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